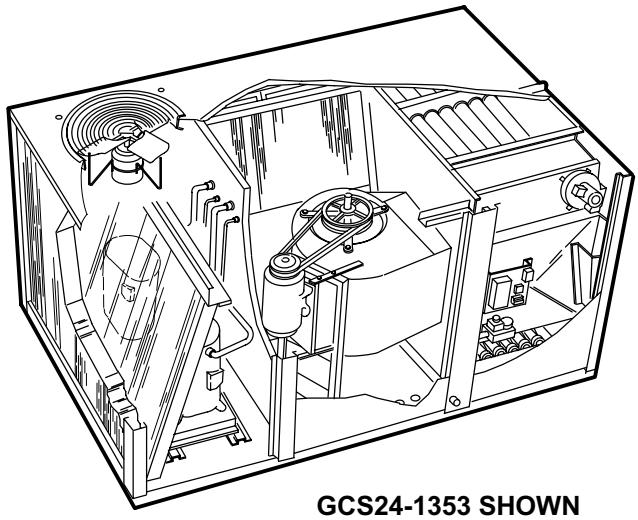
GCS24 SERIES

GCS24 10 and12.5 ton series units are packaged combination two-stage gas heat / two-stage dx cool units designed for commercial applications. Gas heat sections are designed with Lennox' aluminized steel tube heat exchangers ranging in size from 170,000 to 270,000 Btuh input. Both units are equipped with two compressors. Units are designed for rooftop or side of building installation with either bottom or horizontal discharge and return air.

The GCS24 is designed to accept any of several different thermostat control systems with minimum field wiring. Factory or field provided control options connect to the unit with jack plugs. When "plugged in" the controls become an integral part of the unit wiring. Units are also equipped with a low voltage terminal strip to facilitate thermostat field wiring.

Information contained in this manual is intended for use by Lennox service technicians only. All specifications are subject to change. Procedures outlined in this manual are presented as a recommendation only and do not supersede or replace local or state codes. In the absence of local or state codes, the guidelines and procedures outlined in this manual (except where noted) are recommended only.



GCS24-1353 SHOWN

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SPECIFICATIONS

Model No.			GCS24-1353	GCS24-1603
*ARI Standard 210/240 Ratings or Standard ☆360 Ratings	Total cooling capacity — Btuh (kW)		119,000 (34.9)	☆144,000 (42.2)
	Total unit watts		11,780	☆15,500
	EER (Btuh/Watts)		10.1	☆9.3
	Integrated Part Load Value		9.8	☆10.3
★ARI Standard 270 SRN (Bels)			8.4	8.8
Refrigerant (22) Charge	Stage 1		11 lbs. 0 oz. (4.99 kg)	11 lbs. 8 oz. (5.22 kg)
	Stage 2		11 lbs. 0 oz. (4.99 kg)	11 lbs. 8 oz. (5.22 kg)
Evaporator Blower and Drive Selection	Blower wheel nominal dia. x width — in. (mm)		15 x 15 (381 x 381)	15 x 15 (381 x 381)
	Factory Installed ***Drives	Nominal motor hp (W)	3 (2238)	3 (2238)
		Maximum usable hp (W)	3.45 (2574)	3.45 (2574)
		Voltage & phase	208/230/460v or 575v-3ph	208/230/460v or 575v-3ph
		RPM range	730 — 950	730 — 950
Evaporator Coil	Net face area — sq. ft. (m^2)		9.46 (0.88)	11.9 (1.11)
	Tube diameter — in. (mm) & No. of rows		3/8 (9.5) — 4	3/8 (9.5) — 3
	Fins per inch (m)		12 (472)	12 (472)
Condenser Coil	Net face area — sq. ft. (m^2)		30.25 (2.81)	30.25 (2.81)
	Tube diameter — in. (mm) & No. of rows		3/8 (9.5) — 2	3/8 (9.5) — 2
	Fins per inch (m)		20 (787)	20 (787)
Condenser Fans	Diameter — in. (mm) & No. of blades		(2) 22 (559) — 5	(2) 22 (559) — 4
	Air volume — cfm (L/s)		8800 (4155) Total	8800 (4155) Total
	Motor horsepower (W)		(2) 1/2 (373)	(2) 1/2 (373)
	Motor watts		995 Total	995 Total
Sea Level Two Stage Heating Capacity (Natural Gas Only)	Input (low) — Btuh (kW)		170,000 (49.8)	170,000 (49.8)
	Output (low) — Btuh (kW)		132,500 (38.8)	132,500 (38.8)
	Input (High) — Btuh (kW)		270,000 (79.1)	270,000 (79.1)
	Output (High) — Btuh (kW)		216,000 (63.3)	216,000 (63.3)
	A.G.A./C.G.A. Thermal Efficiency		80%	80%
Sea Level Two Stage Heating Capacity (**LPG/Propane Gas Only)	Input (low) — Btuh (kW)		170,000 (49.8)	170,000 (49.8)
	Output (low) — Btuh (kW)		132,500 (38.8)	132,500 (38.8)
	Input (High) — Btuh (kW)		236,250 (69.2)	236,250 (69.2)
	Output (High) — Btuh (kW)		192,500 (56.4)	192,500 (56.4)
	A.G.A./C.G.A. Thermal Efficiency		81.5%	81.5%
♤ High Altitude Two Stage Heating Capacity (Natural Gas Only)	Input (low) — Btuh (kW)		170,000 (49.8)	170,000 (49.8)
	Output (low) — Btuh (kW)		132,500 (38.8)	132,500 (38.8)
	Input (High) — Btuh (kW)		254,000 (74.4)	254,000 (74.4)
	Output (High) — Btuh (kW)		203,200 (59.5)	203,200 (59.5)
	C.G.A. Thermal Efficiency		80%	80%
♤ High Altitude Two Stage Heating Capacity (**LPG/Propane Gas Only)	Input (low) — Btuh (kW)		170,000 (49.8)	170,000 (49.8)
	Output (low) — Btuh (kW)		132,500 (38.8)	132,500 (38.8)
	Input (High) — Btuh (kW)		235,000 (68.9)	235,000 (68.9)
	Output (High) — Btuh (kW)		191,525 (56.1)	191,525 (56.1)
	C.G.A. Thermal Efficiency		81.5%	81.5%
Gas Supply Connections fpt — in. (mm)		Natural	3/4 (19)	3/4 (19)
		**LPG/Propane	3/4 (19)	3/4 (19)
Recommended Gas Supply Pressure — wc. in. (kPa)		Natural	7 (1.7)	7 (1.7)
		**LPG/Propane	11 (2.7)	11 (2.7)
Condensate drain size mpt — in. (mm) PVC			1 (25.4)	1 (25.4)
No. & size of filters — in. (mm)			(4) 16 x 25 x 2 (406 x 635 x 51)	(4) 20 x 25 x 2 (508 x 635 x 25)
Net weight of basic unit — lbs. (kg) (1 Package)			1254 (569)	1313 (596)
Electrical characteristics			208/230v to 575v — 60 hertz — 3 phase	

★Sound Rating Number in accordance with ARI Standard 270.
*Rated in accordance with ARI Standard 210/240 or ☆360; 95°F (35°F) outdoor air temperature and 80°F (27°C) db/67°F (19°C) wb entering evaporator air.
**For LPG/Propane units a field conversion kit is required and must be ordered extra. See Optional Accessories table.
***Using total air volume and system static pressure requirements determine from blower performance tables rpm and motor output required. Maximum usable output of motors furnished by Lennox are shown. In Canada, nominal motor output is also maximum usable motor output. If motors of comparable output are used, be sure to keep within the service factor limitations outlined on the motor nameplate.

OPTIONAL ACCESSORIES (Must Be Ordered Extra)

Unit Model No.			GCS24-1353	GCS24-1603
**LPG/Propane Conversion Kit			LB-55755DA **(32G88)**	
Roof Mounting Frame — (Net Weight)			RMF16-135/160 **(32G91)** (119 lbs.) (54 kg)	
Economizer Dampers	Model No. (Net Weight)		REMD24M-135 (115 lbs.) (52 kg)	REMD24M-160 (128 lbs.) (58 kg)
	Catalog No.	smoke detector	**34J04**	**51J73**
		w/o detector	**34J02**	**54J37**
	No. & size of filters	in.	(2) 16 x 25 x 1	(2) 20 x 25 x 1
		mm	(2) 406 x 635 x 25	(2) 508 x 635 x 25
Exhaust Dampers — (Net Weight) — Net Face Area			GED16-95/135/160 (5 lbs.) (2 kg) — 0.43 sq. ft. (0.04 m^2) **(34G80)**	
Differential Enthalpy Control			**54G44**	
Horizontal Supply and Return Air Kit — (Net Weight)			LB-55756BB **(35G42)** (35 lbs.) (16 kg)	LB-55756BC **(51G27)** (42 lbs.) (19 kg)
Ceiling Supply and Return Air Diffusers (Net Weight)		Step-Down	RTD11-135 **(29G05)** (125 lbs.) (57 kg)	RTD11-185 **(29G06)** (392 lbs.) (178 kg)
		Flush	FD11-135 **(29G09)** (95 lbs.) (43 kg)	FD11-185 **(29G10)** (289 lbs.) (131 kg)
		Transition	SRT16-135 **(97H10)** (38 lbs.) (17 kg)	SRT16-160 **(97H11)** (70 lbs.) (32 kg)
Outdoor Air Dampers	Model No. Net Weight		OAD24-135 (43 lbs.) (20 kg)	OAD24-160 (45 lbs.) (20 kg)
	Catalog No.	smoke detector	**34J05**	**51J76**
		w/o detector	**34J06**	**54J36**
	No. & size of filters — in. (mm)		(1) 16 x 20 x 1 (406 x 508 x 25)	
Automatic Damper Kit — (Net Weight)			**35G21** (7 lbs.) (3 kg)	
Timed-Off Control Kit (2) LB-50709BA			**40G20**	

**For LPG/Propane units a field conversion kit is required and must be ordered extra.

ELECTRICAL DATA

Model No.			GCS24-1353			GCS24-1603		
Line voltage data — 60 Hz — 3 phase			208/230v	460v	575v	208/230v	460v	575v
Compressors (2)	Rated load amps — each (total)		17.3/17.3 (34.6)	9.0/9.0 (18.0)	7.1/7.1 (14.2)	20.8/20.8 (41.6)	8.1/8.1 (16.2)	6.5/6.5 (13.0)
	Locked rotor amps — each (total)		123/123 (246.0)	62/62 (124.0)	50/50 (100.0)	142/142 (288.0)	72/72 (144.0)	58/58 (116.0)
Condenser Fan Motors (2)	Full load amps — each (total)		3.0/3.0 (6.0)	1.5/1.5 (3.0)	1.2/1.2 (2.4)	3.0/3.0 (6.0)	1.5/1.5 (3.0)	1.2/1.2 (2.4)
	Locked rotor amps — each (total)		6.0/6.0 (12.0)	3.0/3.0 (6.0)	2.9/2.9 (5.8)	6.0/6.0 (12.0)	3.0/3.0 (6.0)	2.9/2.9 (5.8)
Evaporator Blower Motor	Motor Output	hp	3	3	3	3	3	3
		W	2238	2238	2238	2238	2238	2238
	Full load amps		10.6	4.8	3.9	10.6	4.8	3.9
	Locked rotor amps		58.0	26.8	23.4	58.0	26.8	23.4
Recommended maximum fuse size (amps)			70	35	25	80	30	25
*Minimum Circuit Ampacity			56.0	29.0	23.0	64.0	26.0	21.0
Unit power factor			.88	.88	.88	.88	.88	.88

*Refer to National or Canadian Electrical Code manual to determine wire, fuse and disconnect size requirements.
NOTE — Extremes of operating range are plus and minus 10 % of line voltage.

BLOWER DATA

GCS24-1353 BLOWER PERFORMANCE

Air Volume cfm (L/s)	STATIC PRESSURE EXTERNAL TO UNIT — Inches Water Gauge (Pa)									
	.20 (50)	.40 (75)	.50 (125)	.70 (175)	.80 (200)	.90 (225)	1.00 (250)	1.10 (275)	1.30 (325)	1.50 (375)
	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)
3600 (1700)	---- ----	672 1.14 (0.85)	707 1.24 (0.93)	772 1.47 (1.10)	802 1.60 (1.19)	831 1.74 (1.30)	860 1.87 (1.40)	887 2.00 (1.49)	940 2.30 (1.72)	985 2.60 (1.94)
3800 (1795)	---- ----	690 1.27 (0.95)	725 1.39 (1.04)	790 1.64 (1.22)	820 1.78 (1.33)	850 1.93 (1.44)	878 2.06 (1.54)	905 2.20 (1.64)	950 2.46 (1.84)	994 2.76 (2.06)
4000 (1890)	642 1.18 (0.88)	715 1.43 (1.07)	746 1.54 (1.15)	809 1.81 (1.35)	838 1.95 (1.45)	866 2.09 (1.56)	895 2.24 (1.67)	920 2.38 (1.78)	968 2.66 (1.98)	1013 2.96 (2.21)
4200 (1980)	670 1.35 (1.01)	736 1.50 (1.12)	768 1.73 (1.29)	828 2.00 (1.49)	856 2.13 (1.59)	885 2.28 (1.70)	913 2.43 (1.81)	938 2.56 (1.91)	984 2.86 (2.13)	1030 3.19 (2.38)
4400 (2075)	693 1.52 (1.13)	760 1.79 (1.34)	790 1.93 (1.44)	850 2.29 (1.71)	878 2.36 (1.76)	905 2.50 (1.87)	930 2.63 (1.96)	955 2.77 (2.07)	1003 3.08 (2.30)	---- ----
4600 (2170)	718 1.70 (1.27)	785 2.00 (1.49)	815 2.15 (1.60)	872 2.44 (1.82)	900 2.59 (1.93)	923 2.71 (2.02)	948 2.84 (2.12)	974 3.00 (2.24)	1021 3.32 (2.48)	---- ----
4800 (2265)	747 1.93 (1.44)	807 2.22 (1.66)	835 2.37 (1.60)	892 2.66 (1.98)	918 2.82 (2.10)	940 2.93 (2.19)	970 3.09 (2.31)	995 3.25 (2.42)	---- ----	---- ----
5000 (2360)	772 2.16 (1.61)	830 2.46 (1.84)	860 2.66 (2.06)	915 2.92 (2.18)	940 3.07 (2.29)	965 3.24 (2.42)	989 3.43 (2.56)	---- ----	---- ----	---- ----
5200 (2455)	800 2.41 (1.80)	860 2.75 (2.05)	887 2.89 (2.16)	940 3.22 (2.40)	965 3.42 (2.55)	---- ----	---- ----	---- ----	---- ----	---- ----

NOTE — All data is measured external to the unit with dry coil and with the air filters in place. See Page 5 for Accessory Air Resistance data.
NOTE — In Canada, maximum usable motor output is 3 hp (2.24 kW).

GCS24-1603 BLOWER PERFORMANCE

Air Volume cfm (L/s)	STATIC PRESSURE EXTERNAL TO UNIT — Inches Water Gauge (Pa)									
	.20 (50)	.40 (75)	.50 (125)	.70 (175)	.80 (200)	.90 (225)	1.00 (250)	1.10 (275)	1.30 (325)	1.50 (375)
	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)	RPM BHP (kW)
4200 (1980)	---- ----	750 1.67 (1.25)	780 1.77 (1.32)	840 2.05 (1.53)	870 2.17 (1.62)	900 2.31 (1.72)	930 2.45 (1.83)	955 2.60 (2.07)	1010 2.90 (2.28)	1045 3.14 (2.34)
4400 (2075)	710 1.59 (1.19)	770 1.83 (1.41)	805 1.99 (1.48	860 2.24 (1.67)	890 2.39 (1.78)	915 2.51 (1.87)	945 2.67 (1.99)	970 2.83 (2.11)	1025 3.12 (2.33)	1060 3.39 (2.53)
4600 (2170)	735 1.78 (1.33)	795 2.13 (1.59)	825 2.17 (1.62)	880 2.45 (1.83)	910 2.60 (1.94)	935 2.75 (2.05)	960 2.89 (2.16)	990 3.06 (2.39)	1040 3.38 (2.66)	1075 3.62 (2.70)
4800 (2265)	760 2.00 (1.49)	820 2.27 (1.69)	850 2.43 (1.81)	905 2.70 (2.01)	930 2.85 (2.13)	955 3.01 (2.25)	980 3.26 (2.43)	1010 3.33 (2.48)	1055 3.63 (2.71)	1090 3.87 (2.89)
5000 (2360)	790 2.26 (1.69)	845 2.53 (1.89)	875 2.68 (2.00)	925 2.96 (2.21)	950 3.11 (2.32)	975 3.27 (2.44)	1000 3.41 (2.54)	1025 3.58 (2.67)	1075 3.94 (2.94)	1110 4.16 (3.10)
5200 (2455)	815 2.50 (1.87)	870 2.80 (2.09)	900 2.95 (2.20)	950 3.25 (2.42)	975 3.42 (2.55)	1000 3.56 (2.66)	1025 3.75 (2.80)	1045 3.88 (2.89)	1095 4.23 (3.16)	1125 4.46 (3.33)
5400 (2550)	840 2.79 (2.08)	895 3.07 (2.29)	920 3.24 (2.42)	970 3.55 (2.65)	995 3.70 (2.76)	1020 3.87 (2.89)	1045 4.09 (3.05)	1070 4.22 (3.15)	1110 4.53 (3.38)	1145 4.81 (3.59)
5600 (2645)	865 3.08 (2.30)	920 3.39 (2.53)	950 3.58 (2.67)	995 3.88 (2.89)	1020 4.05 (3.02)	1045 4.22 (3.15)	1065 4.37 (3.26)	1090 4.57 (3.41)	1130 4.89 (3.65)	1165 5.16 (3.85)
5800 (2735)	895 3.38 (2.52)	945 3.73 (2.78)	980 3.90 (2.91)	1020 4.25 (3.17)	1045 4.42 (3.30)	1065 4.57 (3.41)	1090 4.76 (3.55)	1110 4.93 (3.68)	1150 5.25 (3.92)	1185 5.59 (4.17)

NOTE — All data is measured external to the unit with dry coil and with the air filters in place. See Page 5 for Accessory Air Resistance data.
NOTE — Data in shaded area requires field furnished motor and drive.

NOTE — In Canada, maximum usable motor output is 3 hp (2.24 kW).

BLOWER DATA

ACCESSORY AIR RESISTANCE

Unit Model No.	Air Volume		Total Resistance — inches water gauge (Pa)					
			Wet Evaporator Coil	REMD24M Down-flo Economizer	RTD11 Step-Down Diffuser			FD11 Flush Diffuser
	cfm	L/s			2 Ends Open	1 Side 2 Ends Open	All Ends & Sides Open	
GCS24-1353	3600	1700	.12 (30)	.03 (7)	.36 (90)	.28 (70)	.23 (57)	.15 (37)
	3800	1795	.13 (32)	.04 (10)	.40 (99)	.32 (80)	.26 (65)	.18 (45)
	4000	1890	.14 (35)	.04 (10)	.44 (109)	.36 (90)	.29 (72)	.21 (52)
	4200	1980	.15 (37)	.05 (12)	.49 (122)	.40 (99)	.33 (82)	.24 (60)
	4400	2075	.16 (40)	.05 (12)	.54 (134)	.44 (109)	.37 (92)	.27 (67)
	4600	2170	.17 (42)	.06 (15)	.60 (149)	.49 (122)	.42 (104)	.31 (77)
	4800	2265	.18 (45)	.07 (17)	.65 (162)	.53 (132)	.46 (114)	.35 (87)
	5000	2360	.19 (47)	.09 (22)	.69 (172)	.58 (144)	.50 (124)	.39 (97)
	5200	2455	.20 (50)	.10 (25)	.75 (186)	.62 (154)	.54 (134)	.43 (107)
GCS24-1603	4200	1980	.10 (25)	.06 (15)	.22 (55)	.19 (47)	.16 (40)	.10 (25)
	4400	2075	.11 (27)	.07 (17)	.28 (70)	.24 (60)	.20 (50)	.12 (30)
	4600	2170	.12 (30)	.07 (17)	.34 (85)	.29 (72)	.24 (60)	.15 (37)
	4800	2265	.13 (32)	.08 (20)	.40 (99)	.34 (85)	.29 (72)	.19 (47)
	5000	2360	.14 (35)	.08 (20)	.46 (114)	.39 (97)	.34 (85)	.23 (57)
	5200	2455	.15 (37)	.09 (22)	.52 (129)	.44 (109)	.39 (97)	.27 (67)
	5400	2550	.16 (40)	.10 (25)	.58 (144)	.49 (122)	.43 (107)	.31 (77)
	5600	2645	.17 (42)	.12 (30)	.64 (159)	.54 (134)	.47 (117)	.35 (87)
	5800	2735	.18 (45)	.13 (32)	.70 (174)	.59 (147)	.51 (127)	.39 (97)

CEILING DIFFUSER AIR THROW DATA

Model No.	Air Volume		*Effective Throw Range			
			RTD11 Step-Down		FD11 Flush	
	cfm	L/s	ft.	m	ft.	m
GCS24-1353	4400	2075	34 — 42	10 — 13	32 — 40	10 — 12
	4950	2335	38 — 47	12 — 14	36 — 45	11 — 14
	5500	2595	43 — 52	13 — 16	40 — 50	12 — 15
GCS24-1603	4200	1980	39 — 46	12 — 14	40 — 48	12 — 15
	5000	2360	41 — 50	12 — 15	43 — 52	13 — 16
	5800	2735	43 — 52	13 — 16	45 — 54	14 — 16

*Throw is the horizontal or vertical distance an airstream travels on leaving the outlet or diffuser before the maximum velocity is reduced to 50 ft. (15 m) per minute. Four sides open.

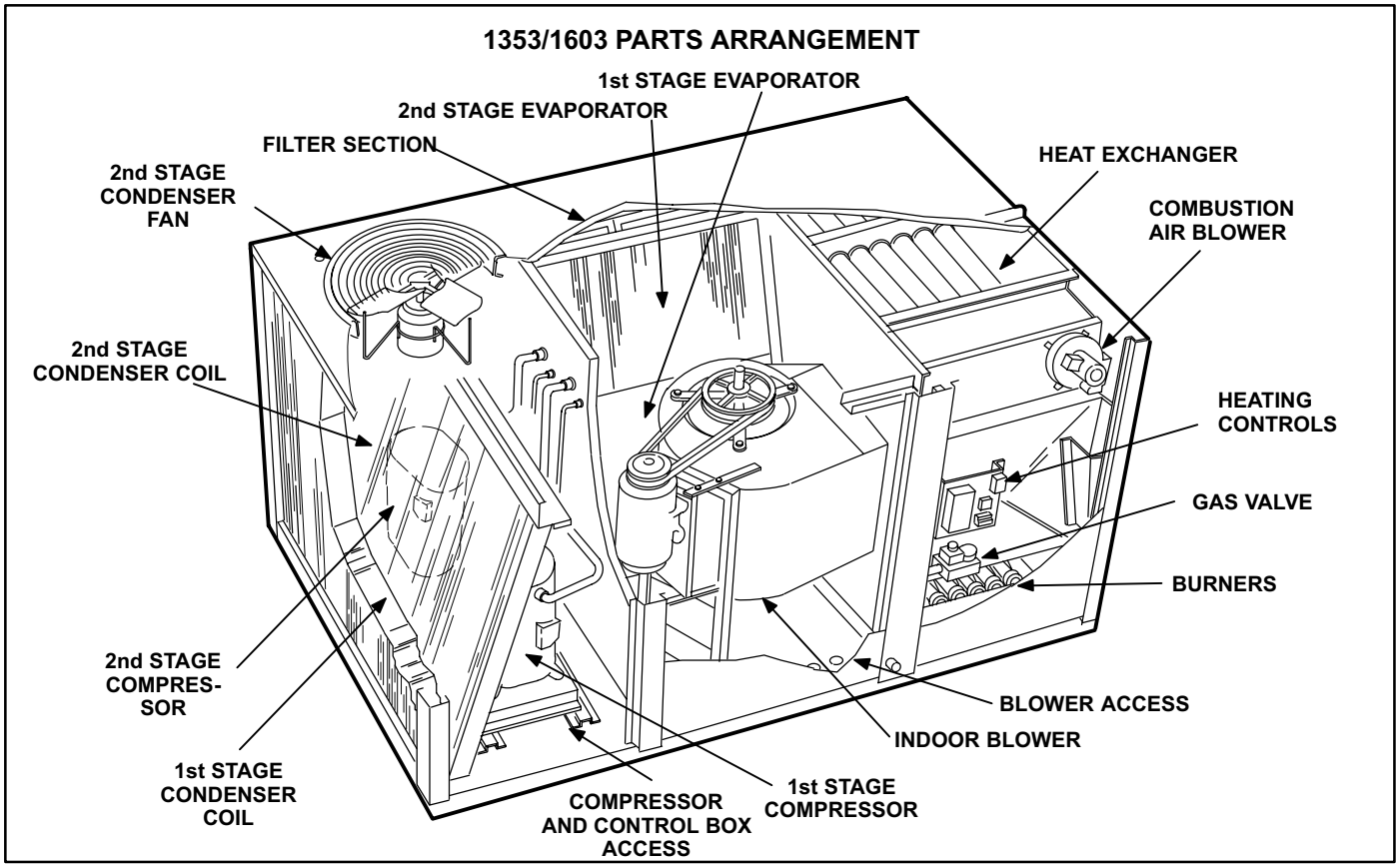


FIGURE 1

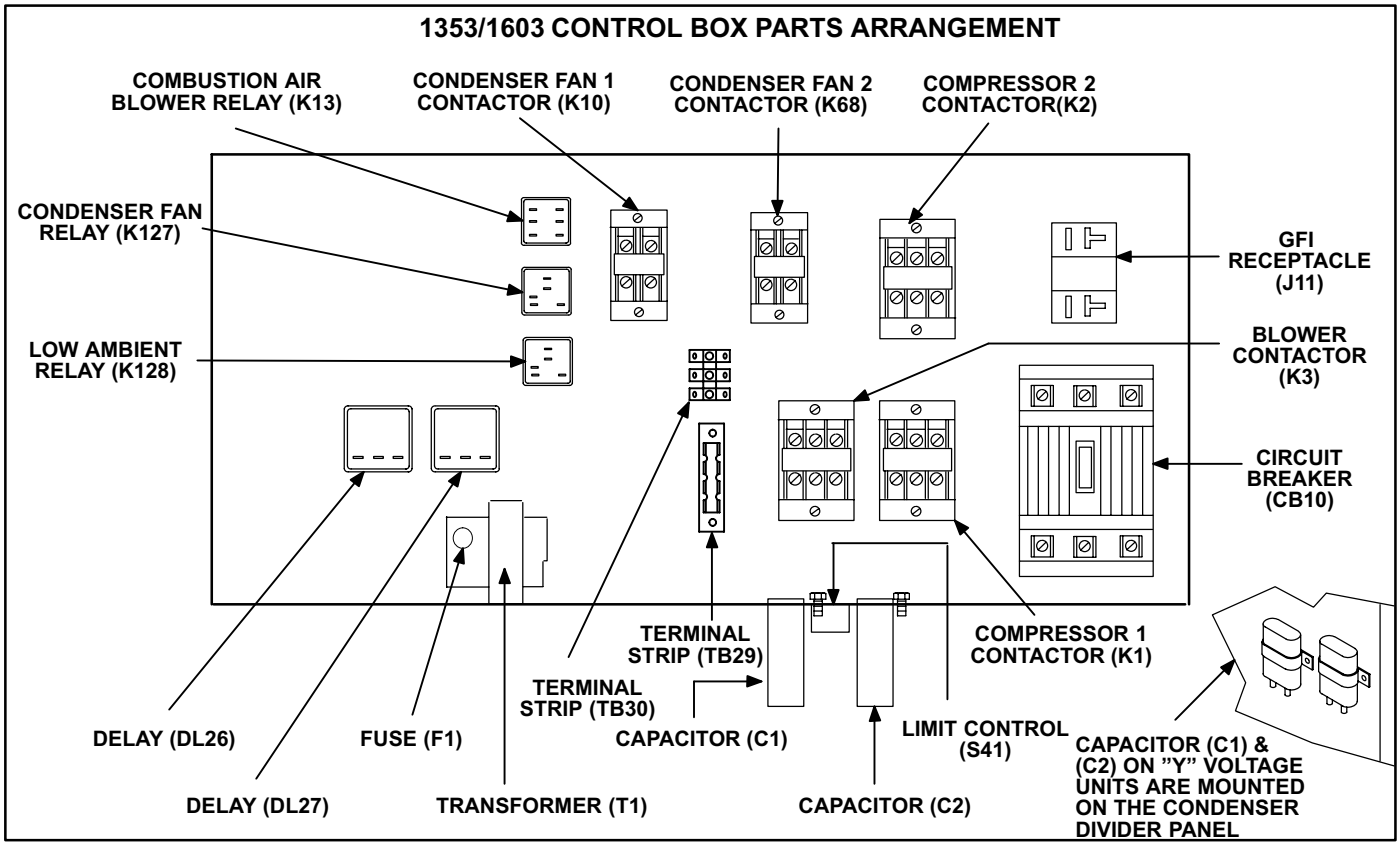


FIGURE 2

I-APPLICATION

GCS24 units are factory equipped with the hardware required for installing Lennox' optional thermostat control systems. Lennox' optional thermostat control systems are the same controls, harnesses, and harness plugs used in all previously released GCS16 commercial units. For example, a Honeywell W973 control will plug in to a GCS16-1603 as easily as it will plug in to a GCS24-1603 (and no field wiring is required for either).

II-UNIT COMPONENTS

For GCS24 series unit components see figure 1.

A-Lifting Brackets

Each unit is equipped with factory installed lifting brackets as shown in figure 3. Brackets are used for lifting the unit during installation or servicing. Lifting brackets can be removed from the unit and reused. If unit must be lifted for service, use only lifting brackets to lift unit.

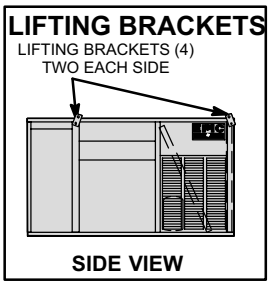


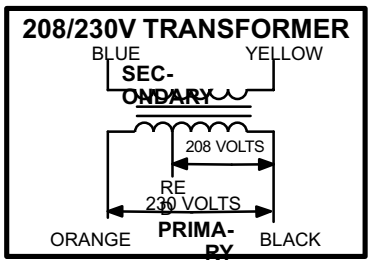
FIGURE 3

B-Control Box Components

GCS24 control box is shown in figure 2. The control box is located in the upper portion of the compressor compartment. The control box has a hinged cover for easy access.

1-Transformer T1 (all units)

All GCS24 series units use a single line voltage to 24VAC transformer mounted in the control box. Transformer supplies power to control circuits in the unit (except the heating section). Transformer is rated at 70VA. 208/230 (Y) voltage transformers use two primary voltage taps as shown in figure 4.



2-Transformer Fuse F1 (all units)

T1 transformer is equipped with an integral fuse connected in series with the blue secondary voltage wire. The fuse may be accessed outside the transformer and is rated 3.5A.

3-Transformer T3 (all 460V and 575V units)

All 460 (G) and 575 (J) voltage units use a single line voltage to 230VAC transformer mounted in the control box. The transformer supplies power to the combustion air blower at all times. It has an output rating of 0.5A.

4-Terminal Strip TB29 and TB30 (late models only)

TB29 and TB30 are terminal strips used for the distribution of 24V power and common from transformer T1 to the control box components. TB29 is for the 24V power and TB30 is for the 24V common.

5-Time Delay DL26 and DL27 (-1603 only)

Time delays DL26 (first stage) & DL27 (second stage) are SPST N.C. time-delay switches. Once energized by the thermostat, the delay waits 12 minutes before opening. The delay protects the compressor from short cycling by bypassing the S87 (first stage) and S88 (second stage) low pressure switches for the first 12 minutes after cooling demand is signaled.

DL26 is wired in series with compressor contactor coil (K1), and DL27 is wired in series with (K2).

6-Compressor Contactor K1 & K2 (all units)

K1 (first stage) & K2 (second stage) are 24V to line voltage contactors used to energize compressors B1 (first stage) & B2 (second stage) in response to first or second stage cooling demands. All units use three-pole-double-break contactors with a 24VAC coil.

NOTE-Contactor K1 is energized by the thermostat control system. Depending on the control system installed, the contactors may or may not be immediately energized upon demand. Refer to the operation sequence for the control system installed.

7-Condenser Fan Relay K127 (all units)

Relay K127 is a 24V to line SPDT pilot-relay used to energize condenser fan contactor K10 during first stage cooling demand from the thermostat.

8-Low Ambient Relay K128 (all units)

K128 is a 24V to line SPDT pilot-relay used to energize condenser fan contactor K68 during second stage cooling demand from the thermostat. In order for K68 to be energized the demand must pass through S84 and S41 (low ambient kit), which are in series with K128.

9-Condenser Fan Contactor K10 & K68 (all units)

Contactors K10 (fan 1) & K68 (fan 2) are 24V to line voltage contactors used to energize condenser fans B4 (fan 1) & B5 (fan 2) in response to thermostat demand. B4 operates throughout all cooling (compressor) demands, while B5 only operates during second stage demand. All units use two-pole-double-break contactors with a 24VAC coil.

10-Combustion Air Blower Relay K13 (all units)

Relay K13 is a DPDT relay located inside the control box. K13 is energized by 1st stage heating demand from thermostat and is energized throughout the heating demand. When energized, K13 normally open contacts close to energize combustion air blower and begin a heating sequence. A centrifugal "prove" switch located in combustion air blower motor closes as the motor nears full speed to "prove" combustion air blower operation. When the switch closes, the ignition control and gas valve are energized to begin a heating sequence.

11-Capacitors C1 & C2 (all units)

Capacitors C1 (first stage) & C2 (second stage) are 370V capacitors used to assist in the start up of condenser fans B4 (first stage) and B5 (second stage). The capacitors are energized by K10 (first stage) & K68 (second stage). Different voltage units have different MFD's. They are as follows: Y voltage,15 MFD; G voltage,12.5 MFD; and J voltage, 10 MFD.

12-Indoor Blower Contactor K3 (all units)

K3 is a 24V to line voltage contactor used to energize the indoor blower motor (B3) and economizer (if used) in response to blower demand. In cooling, as well as heating mode, K3 is energized by thermostat or constant fan demand. All units use three-pole-double-break contactors.

13-Limit Control S41 (all units)

S41 is a SPST N.C. low ambient thermostat switch, which opens on a temperature fall at 55±5 degrees and closes on a temperature rise at 65±6 degrees. It is used to increase the evaporating temperature by energizing and de-energizing the second condenser fan contactor (K68). This intermittent fan operation allows the cooling system to operate in cold conditions without icing the evaporator coil and losing capacity.

14-Circuit Breaker CB10 (all units)

All units are equipped with a circuit breaker CB10 located in the control box. Circuit breaker provides overcurrent protection to the unit. Circuit breakers used are three pole manual reset switches with varying voltage and amperage ratings (depending on tonnage and voltage of the unit).

15-GFI Receptacle J11 (all units)

All units are equipped with a 110 volt ground fault interrupter (GFI) receptacle located in the control box. This provides easy access to electricity for the service person. Separate wiring must be run for 110v receptacle.

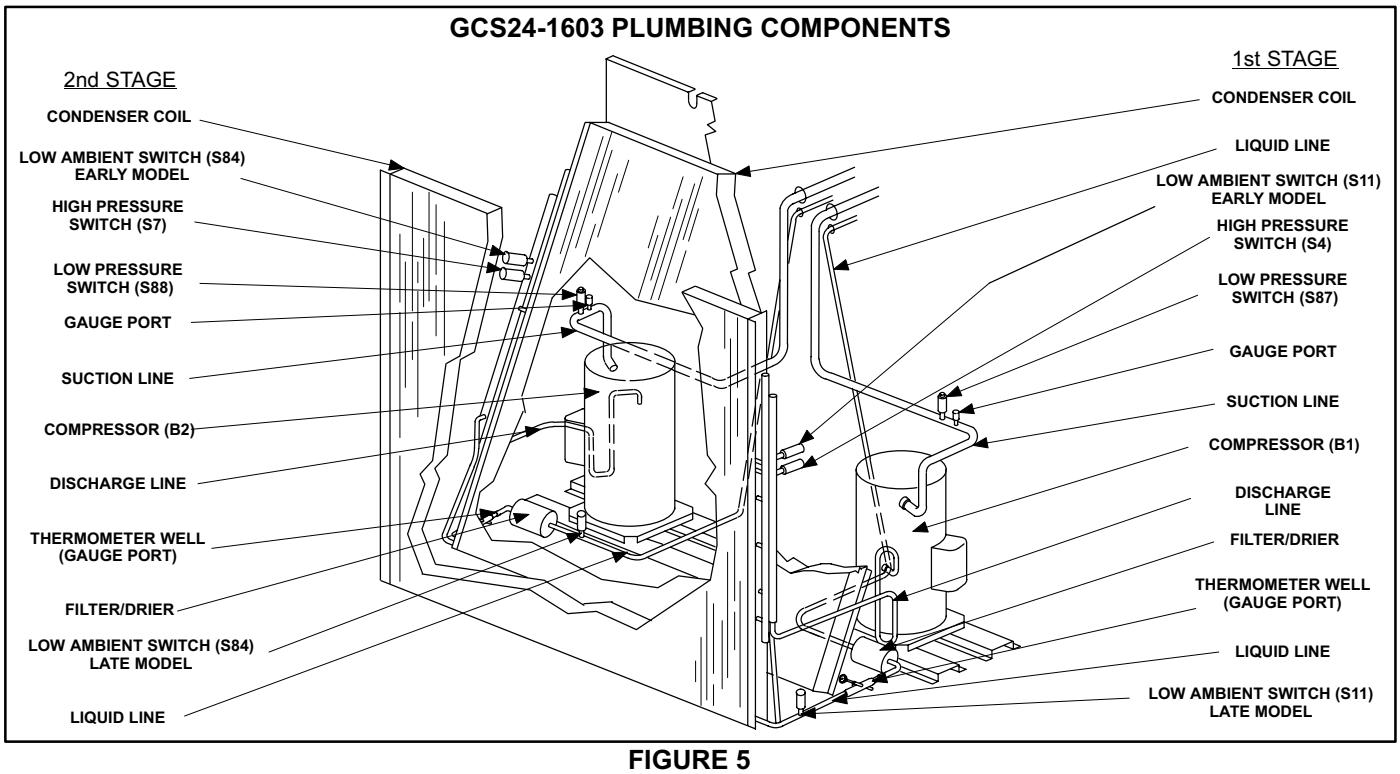


FIGURE 5

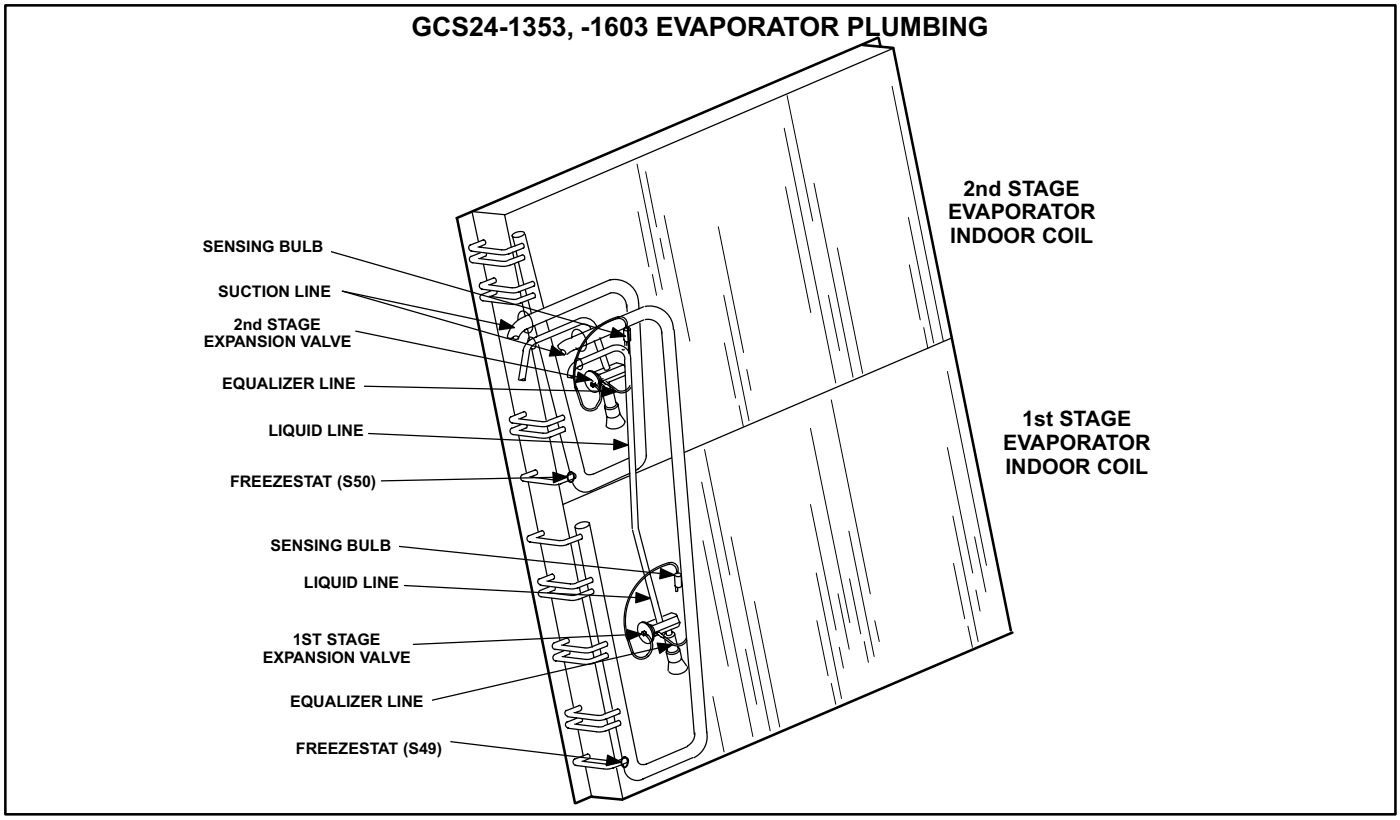


FIGURE 6

C-Cooling Components

Summary of Features

GCS24-1353 / 1603 units use independent cooling circuits consisting of separate compressors, condenser coils and evaporator coils. See figure 5. A draw-through type condenser fan is used in all units. Both 10 and 12.5 ton units have two condenser fans. All 10 and 12.5 ton units are equipped with a single belt-drive blower that draws air across the evaporator during unit operation.

Cooling may be supplemented by field-installed economizer. The evaporators are slab type and are stacked as shown in figure 6. Each evaporator uses a thermostatic expansion valve as the primary expansion device. Each evaporator is also equipped with enhanced fins and rifled tubing. In all units each compressor is protected by a crankcase heater, high pressure switch and low pressure switch. Additional protection is provided by factory installed low ambient thermostat (unit control box) and freezestats (on each evaporator). Each cooling circuit is equipped with a thermometer well for charging.

1-Compressors B1 and B2 (all units)

Ten ton units use two five ton scroll compressors, while 12.5 ton units use two 6.25 ton reciprocating compressors. Compressors are supplied by various manufacturers. All units are equipped with two independent cooling circuits. Compressor electrical specifications vary by manufacturer. Likewise, compressor capacity may vary from first stage to second stage. In all cases, the capacity of each compressor is added to reach the total capacity of the unit. See unit rating plate for specific compressor capacity ratings and electrical data.

⚠ WARNING

Electrical shock hazard. Compressor must be grounded. Do not operate without protective cover over terminals. Disconnect power before removing protective cover. Discharge capacitors before servicing unit. Failure to follow these precautions could cause electrical shock resulting in injury or death.

Compressor B1 operates during all compressor cooling demand and is energized by contactor K1 upon receiving a first stage demand. Compressor B2 operates only during second stage cooling demand and is energized by contactor K2.

NOTE-Refer to wiring diagram section B9 for specific unit operation.

2-Crankcase Heaters HR1 and HR2 (-1353 only)

GCS24-1353 units use belly band type heaters. Heater HR1 is installed around compressor B1, heater HR2 is installed around compressor B2. Crankcase heater wattage varies by compressor manufacturer. See unit rating plate for specific electrical data.

3-High Pressure Limit S4 and S7 (all units)

The high pressure limit is a manually reset SPST N.C. switch which opens on a pressure rise. All GCS24 units are equipped with this limit. The switch is located in the compressor discharge line and is wired in series with the compressor contactor.

S4 is wired in series with the first stage compressor contactor and S7 is wired in series with the second stage compressor contactor.

When discharge pressure rises above 410±10 psig (indicating a problem in the system) the switch opens and the respective compressor is de-energized (the economizer can continue to operate.) After the problem has been found and corrected, reset the switch by pushing in the switch button.

4-Low Ambient Switch S11 and S84 (all units)

The low ambient switch is an auto-reset SPST N.O. switch which allows for mechanical cooling operation at low outdoor temperatures. All GCS24-1353/1603 units are equipped with this switch. The switch is wired in series with the condenser fan relay, low ambient relay and condenser fan contactor. In the early models the switch is located in the compressor discharge line next to the high pressure switch. In the late models the switch is located in the liquid line next to the drier.

S11 is wired in series with the first stage condenser fan B4 and S25 is wired in series with second stage condenser fan B5.

When discharge pressure drops below 150±10psig the switch opens and the condenser fan is de-energized. This intermittent fan operation results in high evaporating temperature which allows the system to operate without icing the evaporator coil and losing capacity. The switch automatically resets when pressure in the discharge line rises above 275±10 psig.

5-Low Pressure Switch S87 & S88 (all units)

The low pressure switch is an auto-reset SPST N.C. switch which opens on a pressure drop. All GCS24 units are equipped with this switch. The switch is located in the compressor suction line and is wired in series with the high pressure switch and compressor contactor.

S87 (first stage) is wired in series with first stage compressor contactor and S88 (second stage) is wired in series with second stage compressor contactor.

When suction pressure drops below 25±5 psig (indicating low pressure) the switch opens and the compressor is de-energized. The switch automatically resets when refrigerant is added and pressure in the suction line rises above 55±5 psig.

6-Thermometer Well (all units)

All units are factory equipped with a thermometer well (figure 7) for charging the unit. The well is used to accurately measure the temperature of the liquid line. The temperature measured is then used to calculate the approach temperature. Approach temperatures are compared to tables printed in the charging section of this manual to determine the correct charge. Thermometer wells are equipped with a gauge port for high pressure gauge connection.

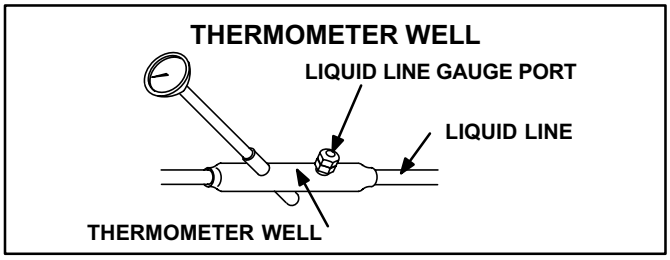


FIGURE 7

To accurately measure the temperature of the liquid line, the well should be filled with a light mineral oil before using. This will ensure good heat transfer to thermometer.

7-Freezestats S49 and S50 (all units)

Each evaporator is equipped with a low temperature limit (freezestat) located on the suction tube at the bottom of each evaporator. S49 is located on the first stage evaporator coil and S50 is located on the second stage evaporator coil.

Each freezestat is wired in series with its respective compressor contactor coil. Each freezestat is a SPST auto-reset limit which opens at 29°F $\pm$ 3°F on a temperature drop and closes at 58°F $\pm$ 4°F on a temperature rise. To prevent coil icing, freezestats open during compressor operation to temporarily disable the respective compressor until the coil warms sufficiently to melt any accumulated frost.

If the freezestats are tripping frequently due to coil icing, check the unit charge, airflow and filters before allowing unit back in operation. Make sure to eliminate all conditions which might promote evaporator ice buildup.

8-Condenser Fans B4 and B5 (all units)

The tables on page 2 in this manual show the specifications of condenser fans used in GCS24 10 and 12.5 ton units. Condenser fans in all GCS24 units use single-phase motors. Both units are equipped with two condenser fans.

D-Blower Compartment / Power Make-Up

1-Indoor Blower Motor B3 (all units)

GCS24 units use three-phase single-speed blower motors. CFM adjustments are made by adjusting the motor pulley (sheave). Motors are equipped with sealed ball bearings. All motors operate at 1725 RPM and are internally overload protected. The Y and G voltage units use the same motor while the J voltage unit uses its own motor. Units may be equipped with motors manufactured by various manufacturers. Electrical FLA and LRA specifications vary by manufacturer. See unit rating plate for information specific to your unit.

2-Low Voltage Terminal Strip TB1

All units are equipped with a low voltage terminal strip TB1 located in the power entry make-up compartment. See figure 9. All low voltage (thermostat) electrical connections can be made to this terminal strip. Knock-outs provided in the base pan of the unit cabinet allow for passage of wires into conduit and roof mounting frame. Special instructions are provided where needed for low voltage connections that cannot be made to the terminal strip. A detailed drawing of TB1 is also shown in figure 8.

TB1 uses spring crimp retainers for securing wires. A small slot screwdriver must be used to depress the spring in order to insert or remove a wire (see figure 8). Strip wire no more than 1/4".

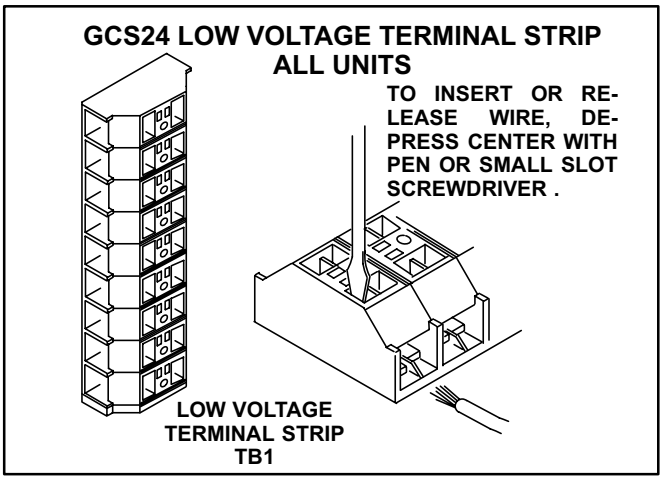


FIGURE 8

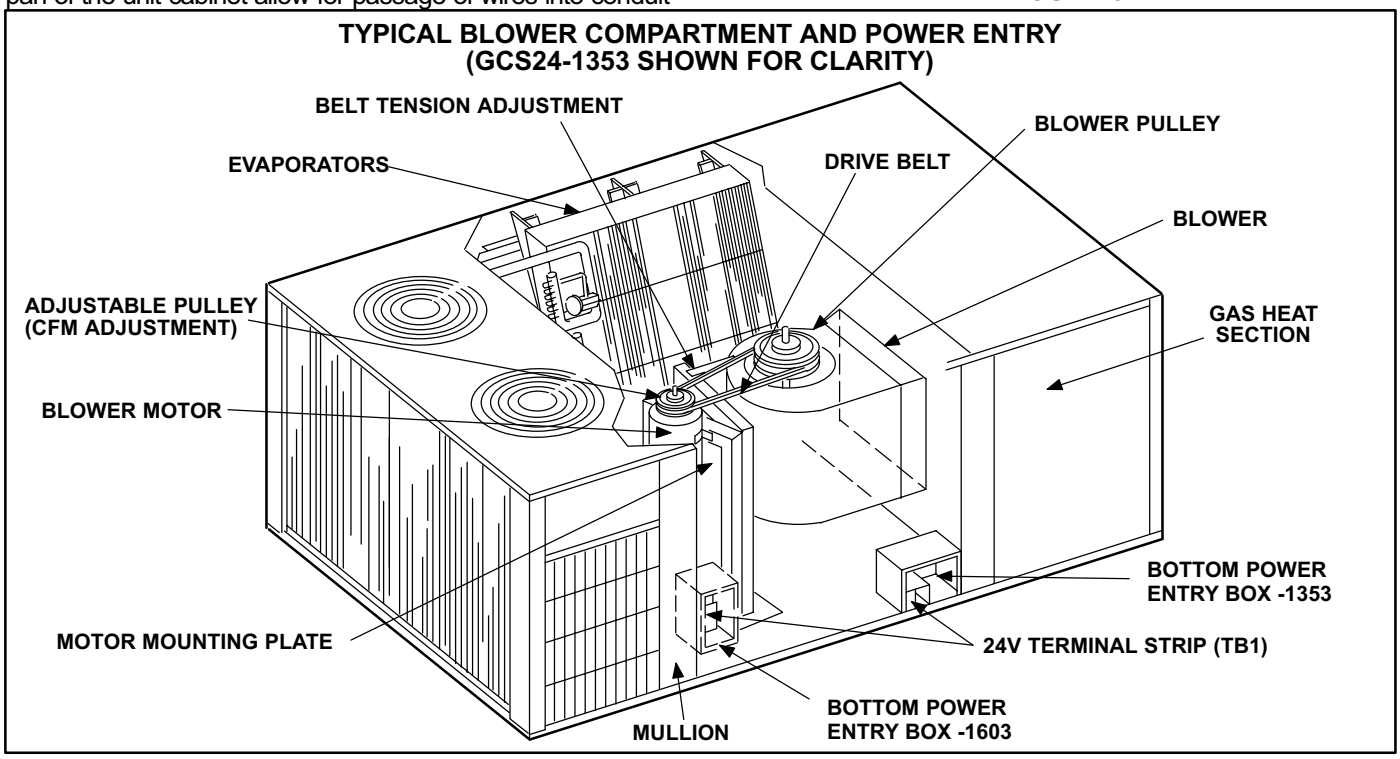


FIGURE 9

III-ELECTRICAL CONNECTIONS

A-Power Supply

Refer to startup directions and refer closely to the unit wiring diagram when servicing. See unit nameplate for minimum circuit ampacity and maximum fuse size. 208/460/575 volt units are factory wired with red wire connected to control transformer primary. 230 volt units are field wired with orange wire connected to control transformer primary.

IV-PLACEMENT AND INSTALLATION

Make sure that the unit is installed in accordance with the installation instructions and all applicable codes. See accessories section for conditions requiring use of the optional roof mounting frame (RMF16).

V-STARTUP - OPERATION

A-Preliminary and Seasonal Checks

1- Make sure the unit is installed in accordance with the installation instructions and applicable codes.

2- Inspect all electrical wiring, both field and factory installed for loose connections. Tighten as required. Refer to unit diagram located on inside of unit control box cover.

3- Check to ensure that refrigerant lines are in good condition and do not rub against the cabinet or other refrigerant lines.

4- Check voltage at the disconnect switch. Voltage must be within the range listed on the nameplate. If not, consult the power company and have the voltage corrected before starting the unit.

5- Recheck voltage and amp draw with unit running. If power is not within range listed on unit nameplate, stop unit and consult power company. Refer to unit nameplate for correct running amps.

6- Inspect and adjust blower belt (see section VII-C-Blower Belt Adjustment).

B-Cooling Startup

NOTE-The following is a generalized procedure and does not apply to all thermostat control systems. Electronic and ramping thermostat control systems may operate differently. Refer to the operation sequence section of this manual for more information.

⚠ WARNING

Crankcase heaters must be energized for 24 hours before attempting to start compressors. Set thermostat so there is no compressor demand before closing disconnect switch. Attempting to start compressors during the 24-hour warm-up period could result in damaged or failed compres-

1- Set fan switch to AUTO or ON and move the system selection switch to COOL. Adjust the thermostat to a setting far enough below room temperature to bring on all compressors. Compressors will start and cycle on demand from the thermostat (allowing for unit and thermostat time delays).

2- Each refrigerant circuit is charged with R-22 refrigerant. See unit rating plate for correct charge amount.

3- Refer to Cooling Operation and Adjustment section for proper method of checking charge.

C-Heating Startup

1 Set the fan switch to AUTO or ON and move the system selection switch to HEAT. Adjust the thermostat setting above room temperature.

2 The indoor blower and first stage gas heat immediately start.

3 Additional stages are controlled by indoor thermostat.

D-Safety or Emergency Shutdown

Turn off power to the unit.

VI-COOLING SYSTEM SERVICE CHECKS

GCS24 is factory charged and requires no further adjustment; however, charge should be checked periodically using the approach method. The approach method compares actual liquid temperature with the outdoor ambient temperature. Thermometer wells have been provided to allow accurate liquid temperature measurement.

A-Gauge Manifold Attachment

Service gauge ports are identified in figure 5. Attach high pressure line to liquid line gauge port on thermometer well. Attach low pressure line to suction line service port.

NOTE-When unit is properly charged liquid line pressures should approximate those in table 2.

B-Charging

All units are factory charged and require no further adjustment; however, check charge during start-up using the approach method outlined below. Approach method compares actual liquid temperature with outdoor ambient temperature. Thermometer wells have been provided to allow accurate liquid temperature measurement.

If the system is completely void of refrigerant, the recommended and most accurate method of charging is to weigh refrigerant into the unit according to the amount shown on the unit nameplate and in the specifications table. If weighing facilities are not available or if the unit is just low on charge, use the following procedures:

⚠ WARNING

Do not exceed nameplate charge under any conditions. Compressor damage will result.

1- This method uses a thermometer inserted in the thermometer wells to check liquid line temperature. *Make sure thermometer wells are filled with oil before checking.*

2- Operate unit (all compressors) for at least five minutes until pressures stabilize.

3- Check each stage separately with all stages operating. Compare liquid temperatures to outdoor ambient temperature. Liquid line temperature should be a few degrees warmer than the outdoor air temperature. See table 1. For best results use the same thermometer for both readings.

TABLE 1

APPROACH TEMPERATURE		
UNIT	LIQUID TEMP. MINUS AMBIENT TEMP.	
	STAGE 1	STAGE 2
CHA/GCS24-1353	6°F ± 1 (3°C ± 0.5)	8°F ± 1 (4°C ± 0.5)
CHA/GCS24-1603	9°F ± 1 (5°C ± 0.5)	12°F ± 1 (7°C ± 0.5)

Add refrigerant to make the liquid line cooler.

Recover refrigerant to make the liquid line warmer.

4- When unit is properly charged, the system pressure should approximate pressure given in the Normal Operating Pressure Table (table 2).

NOTE - Use table 2 as a general guide for performing maintenance checks. When unit is properly charged line pressures should approximate those given in table 2. Table 2 is not a procedure for charging the system. Variations in these pressures may be expected due to differences in installations or conditions such as indoor air volume, humidity and load. Significant deviations could mean that the system is not properly charged or that a problem exists with some component in the system. Used prudently, table 2 could serve as a useful service guide.

TABLE 2

GCS24 NORMAL OPERATING PRESSURES					
Unit	Outdoor Entering Air Temp.	Stage 1		Stage 2	
		Liq. ± 10 PSIG	Suct. ± 5 PSIG	Liq. ± 10 PSIG	Suct. ± 5 PSIG
GCS24-1353	65°F	155	70	165	70
	75°F	180	72	190	70
	85°F	206	73	217	71
	95°F	242	74	248	72
	105°F	270	75	287	75
GCS24-1603	65°F	154	67	170	69
	75°F	180	70	200	71
	85°F	210	72	231	73
	95°F	242	74	264	75
	105°F	277	76	300	77

VII-INDOOR BLOWER OPERATION / ADJUSTMENT

A-Blower Operation

NOTE-The following is a generalized procedure and does not apply to all thermostat control systems.

1- Blower operation is dependent on the thermostat control system option that has been installed in the GCS24. Refer to the operation sequence for the control system installed for detailed descriptions of blower operation.

2- Generally, blower operation is set at the thermostat fan switch. With the fan switch in “ON” position, the blower operates continuously. With the fan switch in “AUTO” position, the blower cycles with demand (or, with some control systems, runs continuously while the heating or cooling circuits cycle).

3- In most cases, the blower and entire unit will be off when the system switch is in the “OFF” position. The only exception is immediately after a heating demand until blower control switches off.

B-Determining Unit CFM

1- The following measurements must be made with a dry indoor coil. Run blower without a cooling demand. Air filters must be in place when measurements are taken.

2- With all access panels in place, measure static pressure external to unit (from supply to return).

3- Measure the indoor blower motor RPM.

4- Referring to tables 3 and 4 , use static pressure and RPM readings to determine unit CFM.

5- The CFM can be adjusted at the motor pulley. Loosen Allen screw and turn adjustable pulley clockwise to increase CFM. Turn counterclockwise to decrease CFM. See figure 10.

TABLE 3
GCS24-1353 BLOWER PERFORMANCE

Air Volume (CFM)	STATIC PRESSURE EXTERNAL TO UNIT — (INCHES WATER GAUGE)																					
	.20		.30		.40		.50		.60		.70		.80		.90		1.00		1.10		1.30	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3600	—	—	—	—	670	1.15	705	1.25	740	1.35	770	1.45	800	1.60	830	1.75	860	1.85	885	2.00	940	2.30
3800	—	—	655	1.15	690	1.27	725	1.40	760	1.50	790	1.65	820	1.80	850	1.95	880	2.05	905	2.20	950	2.46
4000	640	1.20	680	1.30	715	1.45	745	1.55	780	1.65	810	1.80	840	1.95	865	2.10	895	2.25	920	2.40	970	2.65
4200	670	1.35	704	1.45	736	1.50	770	1.75	800	1.85	830	2.00	855	2.15	885	2.30	915	2.45	940	2.55	985	2.85
4400	695	1.50	725	1.65	760	1.80	790	1.95	820	2.05	850	2.30	880	2.35	905	2.50	930	2.65	955	2.75	1005	3.10
4600	720	1.70	755	1.85	785	2.00	815	2.15	845	2.30	870	2.45	900	2.60	925	2.70	950	2.85	974	3.00	1020	3.30
4800	745	1.95	780	2.05	805	2.20	835	2.35	865	2.40	890	2.65	920	2.80	940	2.95	970	3.09	995	3.25	—	—
5000	770	2.15	800	2.30	830	2.45	860	2.65	885	2.75	915	2.90	940	3.05	965	3.24	990	3.45	—	—	—	—
5200	800	2.40	830	2.60	860	2.75	885	2.90	915	2.90	940	3.20	—	—	—	—	—	—	—	—	—	—

TABLE 4
GCS24-1603 BLOWER PERFORMANCE

Air Volume (CFM)	STATIC PRESSURE EXTERNAL TO UNIT — (INCHES WATER GAUGE)																					
	.20		.30		.40		.50		.60		.70		.80		.90		1.00		1.10		1.30	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4200	—	—	715	1.55	750	1.65	780	1.75	810	1.90	840	2.05	870	2.15	900	2.30	930	2.45	955	2.60	1010	2.90
4400	710	1.60	740	1.70	770	1.85	805	2.00	830	2.10	860	2.25	890	2.40	915	2.50	945	2.65	970	2.85	1025	3.10
4600	735	1.80	765	1.80	795	2.15	825	2.15	855	2.35	880	2.45	910	2.60	935	2.75	960	2.90	990	3.05	1040	3.40
4800	760	2.00	790	2.15	820	2.25	850	2.45	875	2.55	905	2.70	930	2.85	955	3.00	980	3.25	1010	3.35	—	—
5000	790	2.25	815	2.35	845	2.55	875	2.70	900	2.80	925	2.95	950	3.10	975	3.25	1000	3.40	—	—	—	—
5200	815	2.50	845	2.65	870	2.80	900	2.95	920	3.10	950	3.25	975	3.40	—	—	—	—	—	—	—	—
5400	840	2.79	870	2.95	895	3.05	920	3.25	950	3.40	—	—	—	—	—	—	—	—	—	—	—	—
5600	865	3.08	895	3.25	920	3.40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5800	895	3.38	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

C-Blower Belt Adjustment

Proper pulley alignment and belt tension must be maintained for maximum belt life.

NOTE-Tension new belt after 24-48 hours of operation. This will allow belts to stretch and seat in grooves. To increase belt tension, loosen two locking bolts and pull mounting plate. Tighten motor mounting plate in vertical position.

Adjusting Unit CFM:

The CFM can be changed by using the following procedure:

1- Remove the blower belt.

2- Loosen the set screws on motor pulley and remove key as shown in figure 10.

3- Turn pulley clockwise to increase CFM and counterclockwise to decrease CFM. One half turn changes blower speed approximately 20 RPM.

NOTE-The pulley is factory set at three turns open.

4- Replace the key and tighten the set screw. Replace and tighten the blower belt.

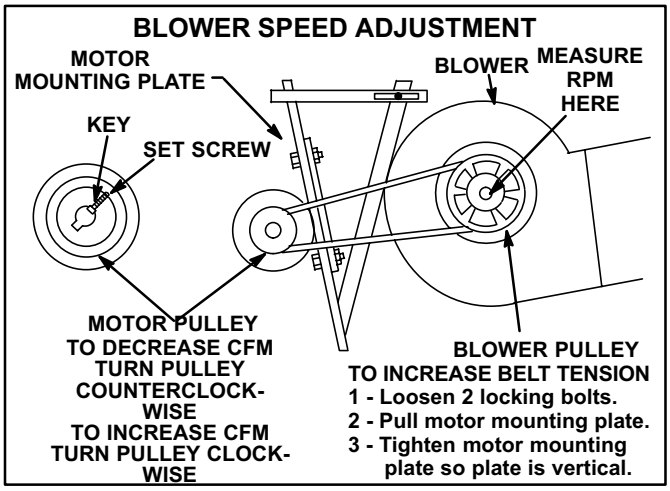


FIGURE 10

VIII-MAINTENANCE

⚠ CAUTION

Electrical shock hazard. Turn off power to unit before performing any maintenance, cleaning or service operation on the unit.

A-Filters (Figure 11)

GCS24 unit is equipped with four pleated 2" throw-away type filters. Permanent 1" foam filters are acceptable replacements. Filters should be checked monthly (or more frequently in severe use) and cleaned or replaced regularly. If permanent foam filters are used as a replacement, they should be checked and cleaned periodically with warm water and a mild detergent. Take note of the "AIR FLOW DIRECTION" marking on the filter frame when reinstalling.

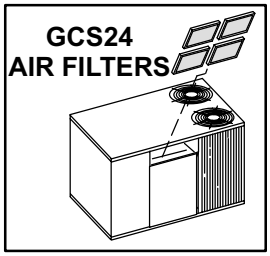


FIGURE 11

NOTE-Filters must be U.L.C. certified or equivalent for use in Canada.

⚠ CAUTION

Be careful when servicing unit to avoid accidental contact with sharp metallic edges which may cause personal injury.

B-Lubrication

All motors used in GCS24 units are prelubricated; no further lubrication is required.

C-Supply Air Blower Wheel

Annually inspect supply air blower wheel for accumulated dirt or dust. Turn off power before attempting to remove access panel or to clean blower wheel.

D-Evaporator Coil

Inspect and clean coil at beginning of each season. Clean using mild detergent or commercial coil cleanser. Check condensate drain pan and line, if necessary. Flush coil and condensate drain with water taking care not to get insulation, filters, return air ducts wet. Check connecting lines and coil for evidence of oil leaks.

E-Condenser Coil

Clean condenser coil annually with detergent or commercial coil cleaner and inspect monthly during the cooling season. Check connecting lines and coil for evidence of oil leaks.

NOTE-If owner complains of insufficient cooling, the unit should be gauged and refrigerant charge checked. Refer to Gauge Manifold Attachment, Checking Charge and Charging sections in this manual.

F-Electrical

1- Check all wiring for loose connections.

2- Check for correct voltage at unit (unit operating).

3- Check amp-draw on both condenser fan motor and blower motor.
Fan Motor Rating Plate ____ Actual _____
Indoor Blower Motor Rating Plate____ Actual____

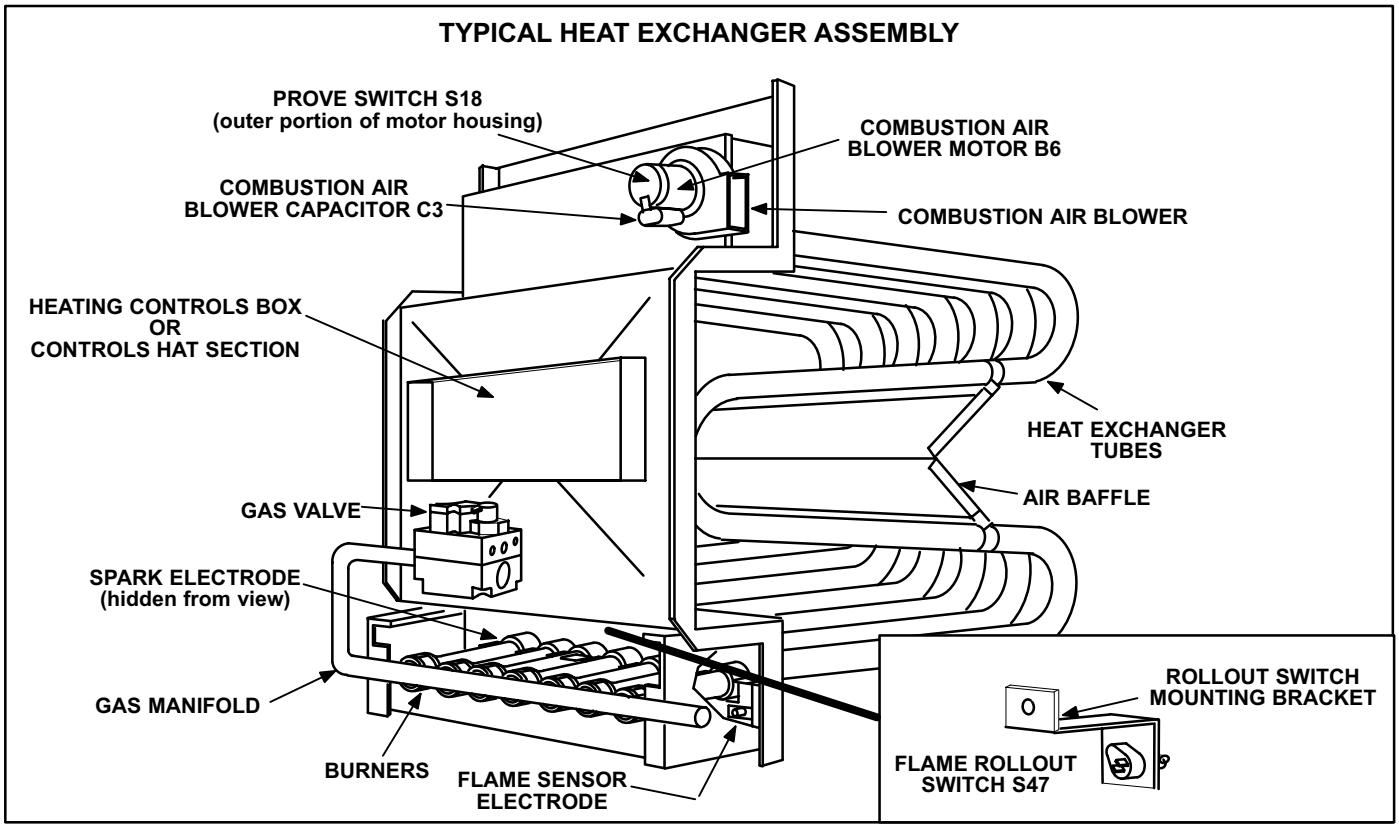


FIGURE 12

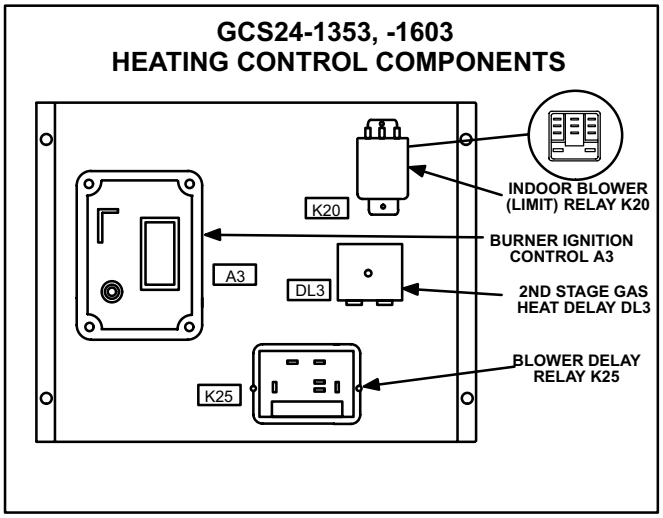


FIGURE 13

IX-GAS HEAT

A-Heating Control Box Components (Figure 13)

1-Indoor Blower (Limit) Relay K20

Relay K20 is a DPDT relay located in the heating control box. Relay K20 is energized when either the primary or secondary high temperature limits trip. When K20-1 is energized, a set of N.O. contacts close to energize relay K3 in the unit. Relay K3 energizes the indoor blower for safety cool-down. When K20-2 is energized, a set of N.C. contacts open to de-energize GV1. When either the primary or secondary limit are reset normal operation is resumed.

2-2nd Stage Gas Heat Delay DL3

DL3 is a SPST time delay located in the heating control box. Upon receiving increased heating demand from W2, DL3 initiates a 180 second time delay before closing its N.O. contacts. DL3 prevents frequent cycling of 2nd stage heat. When DL3 contacts close, 2nd stage operation begins. When 2nd stage heating demand stops time delay DL3 is de-energized and reset immediately. When DL3 resets, the 2nd stage operator of the gas valve is de-energized and closed.

3-Blower Delay Relay K25

A heat type combination blower delay / relay (K25) located in the heating controls box coordinates blower operation with burner operation. K25 is a SPDT relay which closes 40±10 seconds after being energized and opens 110±20 seconds after being de-energized.

4-Burner Ignition Controls A3

All models use direct spark, multiple try ignition. Units are equipped with a single ignition control, spark and flame sensor (A3).

The ignition control is located in the heating control box. It is connected to the unit using jacks J58 and plugs P58. On a heating demand, the ignition control is energized after combustion air blower prove switch (S18) closes. The ignition control then allows 30 to 40 seconds for the combustion air blower to vent exhaust gases from the burners. At the end of the delay the ignition control activates the first stage operator of the gas valve (low fire), the spark electrode, the flame sensing electrode and blower relay. Sparking stops after flame is sensed. The combustion air blower continues to operate throughout the heating demand. If the flame fails or if the burners do not ignite, the ignition control will attempt to ignite the burners up to two more times. If ignition cannot be obtained after the third attempt the control will lock out. The ignition control is not adjustable.

Electronic direct spark ignition with flame rectification sensing is used on all GCS24 units. Flame signal strength ranges from 8 to 20 micro-amps. The ignition control is manufactured by Fenwal.

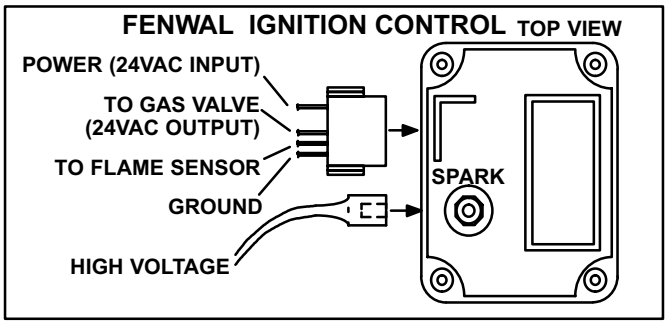


FIGURE 14

The Fenwal control is illustrated in figure 14. The four-wire harness, plugged directly into the jack at the lower corner of the control, is used to connect the control to unit. Each of the four jack terminals is identified by function. The spark electrode wire connects to the spark plug-type connector on top of the control.

⚠ WARNING

SHOCK HAZARD. SPARK RELATED COMPONENTS CONTAIN HIGH VOLTAGE WHICH CAN CAUSE PERSONAL INJURY OR DEATH. DISCONNECT POWER BEFORE SERVICING. CONTROL IS NOT FIELD REPAIRABLE. UNSAFE OPERATION WILL RESULT. IF THE CONTROL IS INOPERABLE, SIMPLY REPLACE THE ENTIRE CONTROL.

The ignition control provides three main functions: gas valve control, ignition and flame sensing. The ignition attempt sequence provides three trials for ignition before locking out. The unit will usually ignite on the first attempt. See figure 15 for a normal ignition sequence with nominal timings for simplicity

Proper gas/air mixture is required for ignition on the first attempt. If there is any deviation, within tolerance of the unit, a second or third trial may be necessary for ignition. The control will lock out the heating system if ignition is not obtained within three trials and the (indoor) blower will not start. Reset after lockout requires only breaking and remaking thermostat demand. See figure 16 for the ignition attempt sequence with retrials (minimal timings given for simplicity). Loss of flame during a heating cycle is indicated by an absence of flame signal (0 microamps). If this happens, the control will immediately restart the ignition sequence and then lock out if ignition is not gained after the third trial.

Specific timings for the Fenwal control are shown in figure 17.

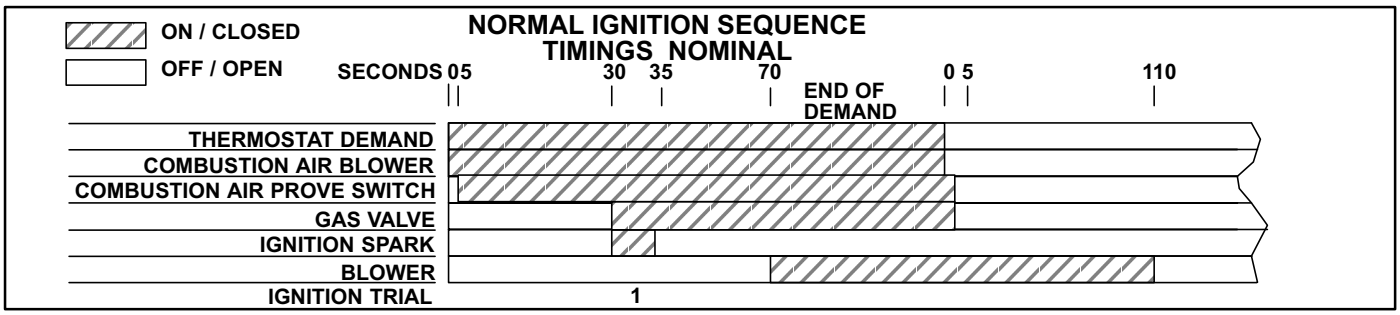


FIGURE 15

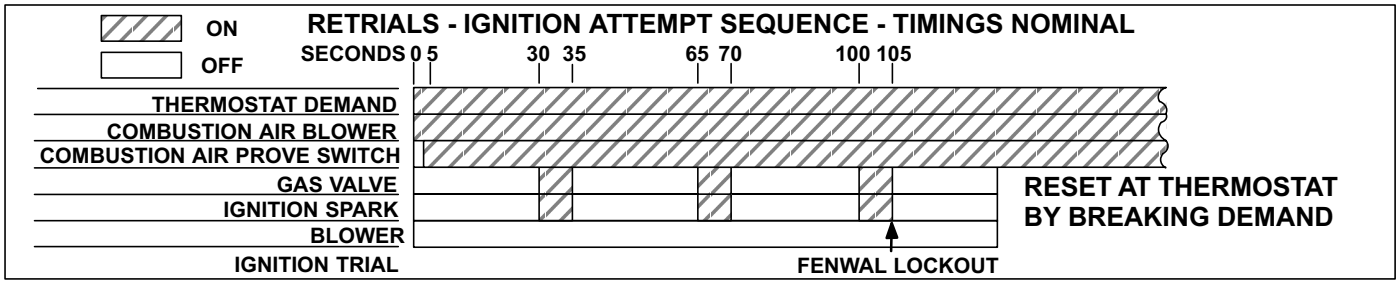
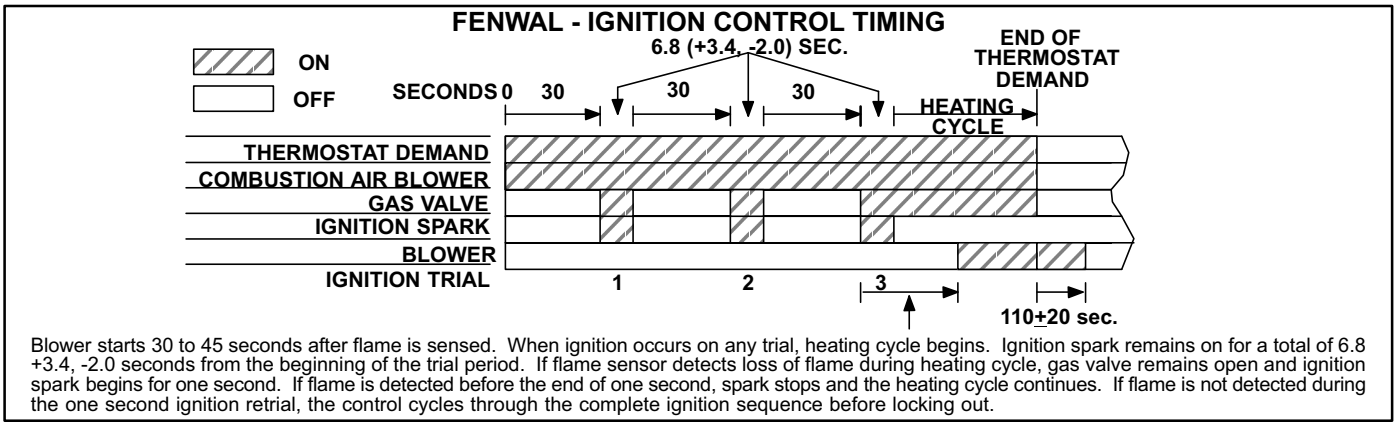


FIGURE 16



Blower starts 30 to 45 seconds after flame is sensed. When ignition occurs on any trial, heating cycle begins. Ignition spark remains on for a total of 6.8 +3.4, -2.0 seconds from the beginning of the trial period. If flame sensor detects loss of flame during heating cycle, gas valve remains open and ignition spark begins for one second. If flame is detected before the end of one second, spark stops and the heating cycle continues. If flame is not detected during the one second ignition retrial, the control cycles through the complete ignition sequence before locking out.

FIGURE 17

B-Heat Exchanger (Figure 12)

The GCS24 uses aluminized steel inshot burners with matching tubular aluminized steel heat exchangers and a two-stage redundant gas valve. The GCS24 uses an eight tube/burner assembly. Each burner uses a burner venturi to mix gas and air for proper combustion. Combustion takes place at each tube entrance. As hot combustion gases are drawn upward through each tube by the combustion air blower, exhaust gases are drawn out the top and fresh air/gas mixture is drawn in at the bottom. Heat is transferred to the air stream from all surfaces of the heat exchange tubes. The supply air blower, controlled by the ignition control or the control system (depending on which control system is installed), forces air across all surfaces of the tubes to extract the heat of combustion. The shape of the tubes and a deflector ensure maximum heat exchange.

The gas valve accomplishes staging by allowing more or less gas to the burners as called for by heating demand. Heat exchangers accomplish staging by cycling the second stage operator of the gas valve. When thermostat demand calls for more heat, the second operator of the gas valve opens to allow more gas to the burners.

C-Burner Assembly (Figure 18)

The burners are controlled by the spark electrode, flame sensing electrode, gas valve GV1 and combustion air blower. The spark electrode, flame sensing electrode and gas valve are directly controlled by the ignition control. The ignition control is controlled by the combustion air blower. The combustion air blower is controlled by heating demand from the thermostat or control system.

1-Burners

All units use inshot burners (see figures 18 and 19).

Burners are factory set and do not require adjustment. Burner air shutters are designed to be fully open only. A peep hole with cover is furnished in the heating access panel for flame viewing. Always operate the unit with the access panel in place. Burners can be removed individually for service. Burner maintenance and service is detailed in the SERVICE CHECKS sections of this manual.

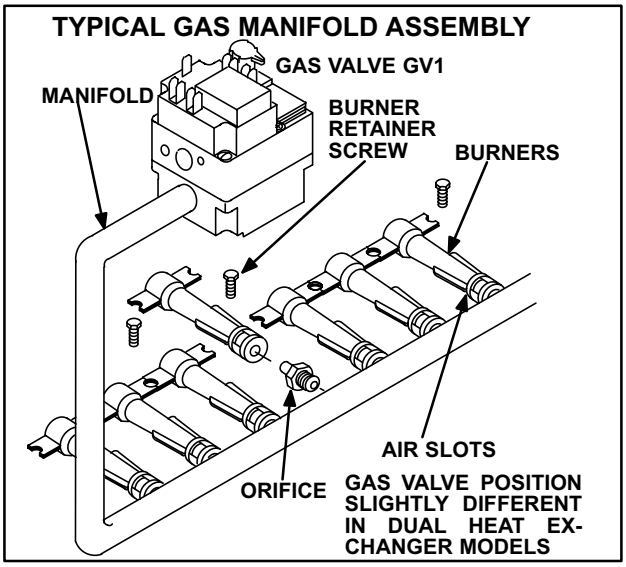


FIGURE 18

2-Orifice

Each burner uses an orifice which is precisely matched to the burner input. The orifice is threaded into the burner manifold. The burner is supported by the orifice and will easily slide off for service.

Each orifice and burner are sized specifically to the unit. Refer to Lennox Repair Parts Listing for correct sizing information.

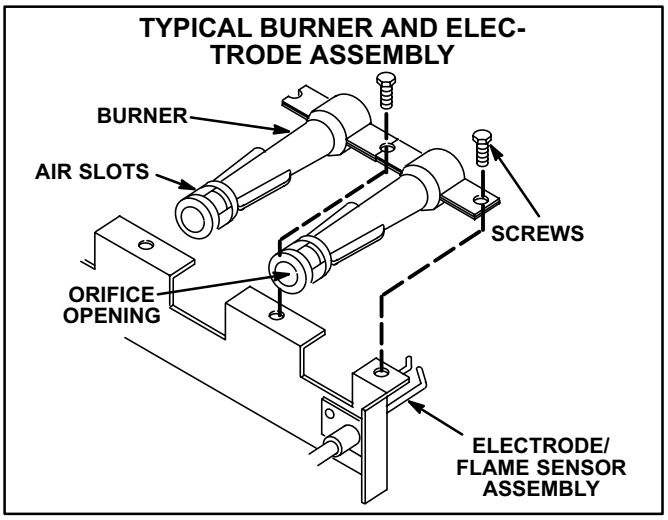


FIGURE 19

D-Primary High Temperature Limit S10

S10 is the primary high temperature limit. It is located in the heating compartment and is mounted to the lower portion of the panel dividing the heating compartment from the blower compartment.

Primary limit S10 is wired in series with the ignition control. Its N.C. contacts open to de-energize the ignition control when excessive temperature is reached in the blower compartment. The limit is a SPDT auto-reset switch. The limit is factory preset to open its N.C. terminals at 180°F ±6°F on a temperature rise and automatically reset at 140°F ±7°F on a temperature fall. The ignition circuit is immediately de-energized when terminals 1-3 open and relay K20 is energized when terminals 1-2 close. This is a primary safety shut-down function of the unit.

E-Secondary High Temperature Limit S21

S21 is the secondary high temperature limit. It is also located in the heating compartment and is mounted to the upper portion of the panel dividing the heating compartment from the blower compartment.

S21 is also wired in series with the ignition control. It functions in the same manner as S10 but is factory set to trip at 150°F ±6°F on a temperature rise and automatically reset at 110°F ±7°F on a temperature fall. This is a secondary safety shut-down function of the unit.

F-Flame Rollout Switch S47

Flame rollout switch S47 is a high temperature limit located just above the burner air intake opening in the burner enclosure. The SPST N.C. limit is connected in series with ignition control A3. When S47 senses flame rollout (indicating a blockage in the combustion air passages), S47 trips, the ignition control immediately stops ignition and closes the gas valve. The switch is factory set to trip at 180°F and cannot be adjusted. The limit is a manual reset switch.

G-Combustion Air Prove Switch S18

The combustion air prove switch (S18) is a SPST N.O. centrifugal switch inside the combustion air motor. It is used to monitor combustion air blower operation. The switch is wired in series with ignition control A3. On startup, the switch closes when the combustion air motor reaches between 1850 and 2500 RPM to allow power to the ignition control (proves, by closing, that the combustion air blower is operating before allowing the ignition control to energize). At the end of a heating demand (when combustion air motor is de-energized), S18 opens when the combustion air motor slows 50 to 450 RPM below the "make." The combustion air prove switch is factory set and is not adjustable.

H-Combustion Air Blower B6

The combustion air blower provides fresh air to the burner while clearing the combustion chamber of exhaust gases. The blower begins operating immediately upon receiving a thermostat demand and is de-energized immediately when thermostat demand is satisfied.

All combustion air blower motors are sealed and cannot be oiled. The blower cannot be adjusted but can be disassembled for cleaning.

The combustion air blower uses a single-phase PSC motor which requires a run capacitor (C3). All motors operate at 3200RPM. All have automatic reset overload protection. Blowers are supplied by various manufacturers. Combustion Air Blower Ratings may vary by manufacturer. Specific blower electrical ratings can be found on the unit rating plate. Both GCS24-1353 and -1603 use 4.81 x 1.25 blower wheel and requires T3 when used on 460v or 575v units.

I-Combustion Air Motor Capacitor C3

The combustion air blower in all GCS24 units uses a 208/230V single-phase PSC ball-bearing motor which requires a run capacitor. Capacitor C3 is connected to combustion air blower B6 and is a 3 MFD-370VAC capacitor.

J-Gas Valve GV1

GV1 is a gas valve used in GCS24 series units. All units are equipped with gas valve GV1.

Gas valve GV1 is a two-stage redundant valve. Units may be equipped with valves manufactured by either Honeywell or White-Rodgers. First stage is quick opening (on and off in less than 3 seconds). Second stage is slow opening (on in 1 minute, off in 1-1/2 minute) On a call for first stage heat, the valve is energized by the ignition control simultaneously with the spark electrode. On a call for second stage heat, the second stage operator is energized after time delay DL3 closes. When demand is satisfied, second stage must be closed (1-1/2 minutes to close completely) before 1st stage can close. A manual shut-off knob is provided on the valve for shut-off. Manual shut-off knob immediately closes both

stages without delay. Figure 20 shows Honeywell gas valve components and figure 21 shows White-Rodgers gas valve components. Table 5 shows factory gas valve regulation for GCS24 series units.

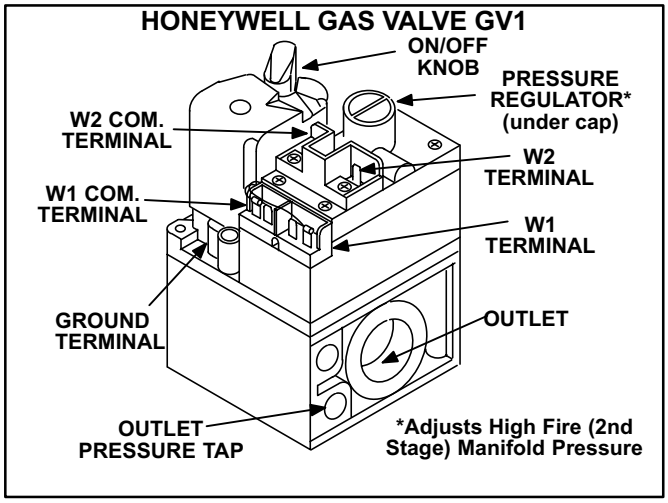


FIGURE 20

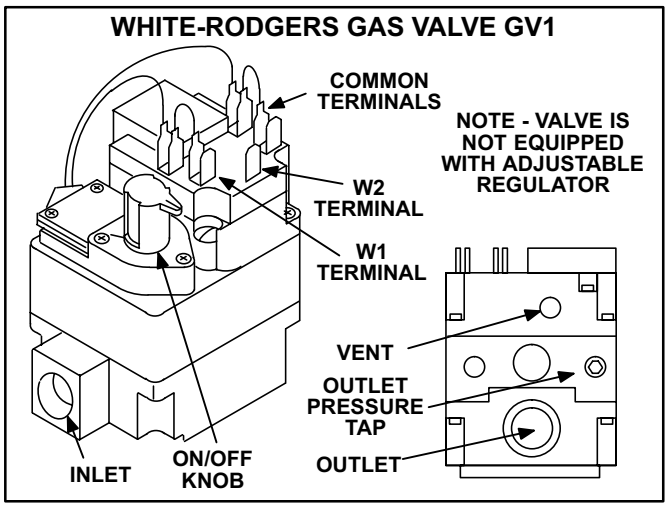


FIGURE 21

TABLE 5

GAS VALVE REGULATION					
Unit Input K Btuh	Maximum Inlet Pressure in. W.C.	Operating Pressure (outlet) in. W.C. Factory Setting			
		Natural*		L.P.**	
		Low	High	Low	High
All Units	13.0	1.6±0.1	3.7±0.2	5.5±0.3	10.5±0.5

* Adjustable Range 3.0 to 5.0 in. W.C. Honeywell Gas Valve only. White-Rodgers gas valve is not adjustable.
** Field Installed Kit Adjustable Range 8.0 to 12.0 in. W.C.Honeywell Gas Valve only. White-Rodgers gas valve is not adjustable.

K-Electrode Assembly

An electrode assembly is used for both ignition spark and flame sensing. Two identical electrodes are used. Each electrode is mounted at extreme ends of the burner support. The electrodes are mounted through holes in the burner support and the electrode tips protrude into the flame envelope of the adjacent burner. The electrode on the left acts as the flame ignitor and the electrode on the right acts as the flame sensor. The electrode assembly is fastened to burner supports and can be removed for service without removing any part of the burners.

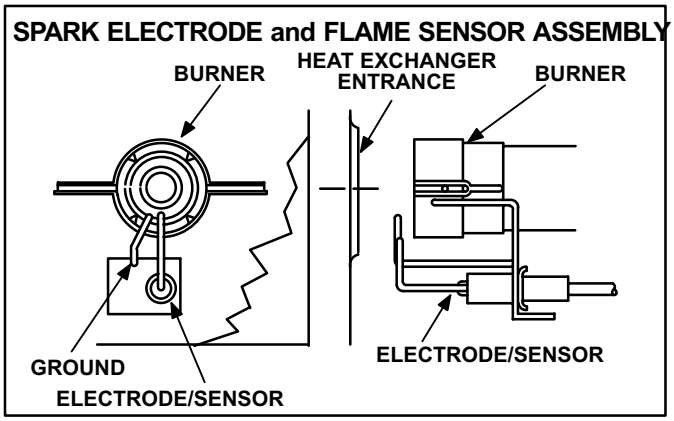


FIGURE 22

During ignition, spark travels through the spark electrode (left) and ignites the left burner. Flame travels from burner to burner until all are lit. When flame is sensed by the right electrode (rightmost burner lit - indicated by microamp signal through the flame) sparking stops. During operation, flame is sensed by current passed along the ground electrode, through the flame and into the sensing electrode. The ignition control allows the gas valve to stay open as long as a flame signal (current passed through the flame) is sensed.

1-Spark Electrode

The spark electrode is connected to the ignition control by a 5mm silicone insulated stranded high voltage wire. The wire uses 1/4" female quick connect on the electrode end and female spark plug-type terminal on the ignition control end.

NOTE-IN ORDER TO MAXIMIZE SPARK ENERGY TO ELECTRODE, HIGH VOLTAGE WIRE SHOULD TOUCH UNIT CABINET AS LITTLE AS POSSIBLE.

2-Flame Sensor

Flame is sensed by rectification through the flame sensing electrode.

X-HEATING SYSTEM SERVICE CHECKS

A-A.G.A./C.G.A. Applications and Requirements

All GCS24s are A.G.A and C.G.A. design certified without modification.

Before checking piping, check with gas company or authorities having jurisdiction for local code requirements. Refer to the GCS24 Operation and Installation Instruction Manual for more information.

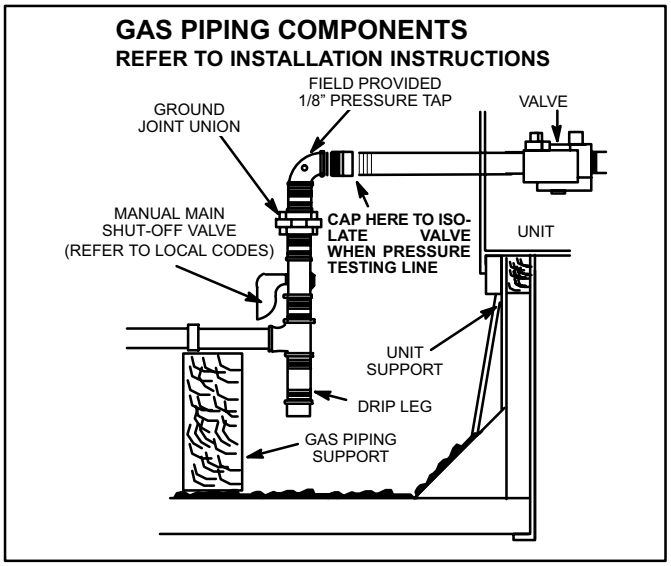


FIGURE 23

B-Gas Piping

Gas supply piping must not allow more than 0.5"W.C. drop in pressure between the gas meter and the unit. Supply gas pipe must not be smaller than the unit gas connection. Refer to installation instructions for details.

C-Testing Gas Piping

NOTE-In case emergency shutdown is required, turn off the main manual shut-off valve and disconnect the main power to the unit. These controls should be properly labeled by the installer.

When pressure testing gas lines, the gas valve must be disconnected and isolated. Gas valves can be damaged if subjected to more than 0.5 psig (14"W.C.). See figure 23.

If the test pressure is equal to or less than 0.5 psig (14"W.C.), use the main manual shut-off valve before pressure testing to isolate unit from gas supply.

When checking piping connection for gas leaks, use the preferred means. Common kitchen detergents can cause harmful corrosion on various metals used in gas piping. The use of specialty Gas Leak Detector is strongly recommended. It is available through Lennox under part number 31B2001. See CORP 8411-L10, for further details.

Do not use matches, candles, flame or any other source of ignition to check for gas leaks.

D-Testing Gas Supply Pressure

When testing gas supply pressure, connect test gauge to the inlet pressure tap (field provided - figure 23). Test supply gas pressure with unit firing at maximum rate (both stages energized). Make sure the reading falls within the range of the following values. Low pressure may result in erratic operation or "underfire." High pressure can result in permanent damage to the gas valve or "overfire." For natural gas units, operating pressure at the unit gas connection must be between 5.5"W.C. and 13.5"W.C. For L.P. gas units, operating pressure at the unit gas connection must be between 10.8"W.C. and 13.5"W.C.

On multiple unit installations, each unit should be checked separately while operating at maximum rate, with and without the other units operating. Supply pressure must fall within the range listed in the previous paragraph. On multiple unit installations, each unit should be checked in sequence beginning with the one closest to the supply gas main and progressing to the one furthest from the main.

E-Check and Adjust Manifold Pressure

After line pressure has been checked and adjusted, check manifold pressure. Move test gauge to the outlet pressure tap located on unit gas valve GV1. See figures 20 and 21 for location of pressure tap on the gas valve.

The manifold pressure is factory set and should not require adjustment. White-Rodgers gas valve is not adjustable. If manifold pressure is incorrect and no other source of improper manifold pressure can be found, the valve must be replaced. Honeywell gas valve can be adjusted from 3.0" W.C. to 5.0" W.C. Refer to figure 20 for location of Honeywell gas valve (manifold pressure) adjustment screw.

All gas valves are factory regulated. The gas valve should completely and immediately cycle off in the event of gas or power failure. The manual shut-off knob can be used to immediately shut off gas supply.

⚠ CAUTION

For safety, connect a shut-off valve between the manometer and the gas tap to permit shut off of gas pressure to the manometer.

Manifold Adjustment Procedure

1- Connect test gauge to the outlet pressure tap on the gas valve. Start the unit (call for 2nd stage heat) and allow five minutes for the unit to reach steady state.
2- While waiting for the unit to stabilize, notice the flame. The flame should be stable without flashback and should not lift from the burner heads. Natural gas should burn basically blue with some clear streaks. L.P. gas should burn mostly blue with some clear yellow streaks.
3- After allowing the unit to stabilize for five minutes, record the manifold pressure and compare to the values given for gas supply pressure (above).

⚠ CAUTION

Disconnect heating demand as soon as an accurate reading has been obtained.

F-Proper Gas Flow

To check for proper gas flow to burners, determine Btuh input from unit rating plate or table 6. Divide this input rating by the Btuh per cubic foot of available gas. Result is the number of cubic feet per hour required. Determine the flow of gas through gas meter for two minutes and multiply by 30 to get hourly flow of gas to the burners.

NOTE - To obtain accurate reading, shut off all other gas appliances connected to meter.

TABLE 6

Unit	Fuel	Stage	Input Btuh	Output Btuh	Input ($ft.^3$/hr.)
GCS24 1353-270 1603-270	Nat.	1st	170,000	132,500	
		2nd	270,000	216,000	
GCS24 1353-270 1603-270	L.P.G.	1st	170,000	132,500	
		2nd	236,250	192,500	

G-High Altitude Derate Units With Adjustable Regulator Only (Honeywell Gas Valve)

The maximum input may be reduced by up to 20 percent on A.G.A. units equipped with adjustable (Honeywell) gas valves and operating on natural gas. See table 7.

To derate the unit use the following instructions. If high altitude conditions are present, also follow the instructions in table 7.

Derate Procedure:

1- Check manifold pressure at the gas valve pressure tap with unit operating at high fire (2nd stage).
2- To reduce maximum input, turn regulator adjusting screw (figure 20) counterclockwise.
3- Re-check manifold pressure.

TABLE 7

HIGH ALTITUDE DERATE

If the heating value of the gas does not exceed the values listed in this table, derating of unit is not required. Should the heating value of the gas exceed the table values, or if the elevation is greater than 6,000 ft. above sea level, it will be necessary to derate the unit. Lennox requires that derate conditions be 4 percent per thousand feet above sea level. Thus at an altitude of 4000 feet, if the heating value of the gas exceeds 1000 Btu/cubic ft., the unit will require a 16 percent derate.

Elevation Above Sea Level (Feet)	Maximum Heating Value (Btu/cubic ft.
5001-6000	900
4001-5000	950
3001-4000	1000
2001-3000	1050
Sea Level - 2000	1100

H-Inshot Burner

Air shutters are factory set for maximum air and cannot be adjusted. Air shutters should always be fully open. Always operate unit with access panel in place. A peep hole is furnished in the heating access panel for flame viewing. The flame should be blue with yellow streaks.

Figure 24 shows how to remove burner assembly.

1- Turn off power to unit and shut off gas supply.
2- Remove screws as shown in figure 24.
3- Slide each burner off its orifice.
4- Clean and reassemble (reverse steps 1-3).
5- Be sure to secure all wires and check plumbing.
6- Turn on power to unit. Follow lighting instructions attached to unit and operate unit in heating mode. Check burner flames. They should be blue with yellow streaks.

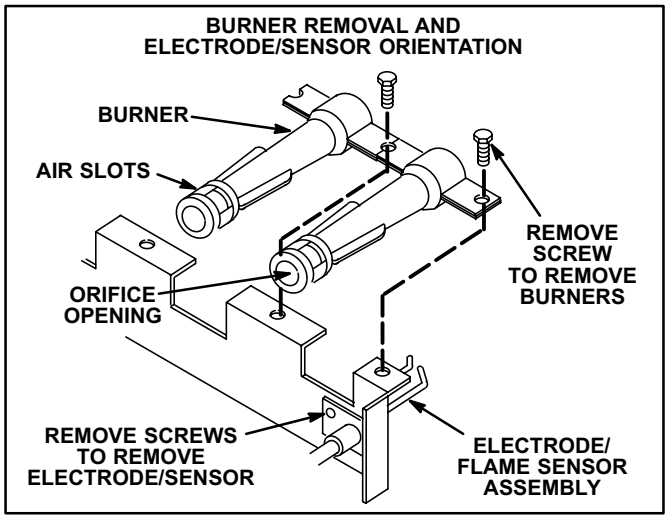


FIGURE 24

NOTE-If the unit is operated with the heating access panel off and burners cold, the burner sound will increase due to cold, dense primary air. This is normal and will subside when heat exchanger warms up during operation. The sound will be further reduced with the access panel in place.

I-Heat Exchanger

To Access or Remove Heat Exchanger From Unit:

1- Turn off gas and electric power.
2- Remove access panel and unit end panel.
3- Remove gas valve, manifold assembly and burners.
4- Remove combustion air blower and flue box. Pay careful attention to the order in which gaskets and orifice are removed.
5- Support heat exchanger (to prevent it from falling when final bolts are removed.)
6- Remove bolts supporting heat exchanger.
7- To install heat exchanger, reverse procedure. Be sure to secure all wires and check plumbing and burner plate for airtight seal. Bolts must be torqued to 35 in.-lbs. to ensure proper operation.

J-Ignition (Burner) Control A3

Ignition control is factory set and is not adjustable. The control makes three attempts at ignition and then locks out the system if ignition is not obtained after the third trial. Reset after lockout requires only breaking and remaking thermostat demand. The control shuts off gas flow immediately in the event of a gas or power failure. Upon restoration of gas and power, the control will restart the ignition sequence and continue until flame is established or system locks out.

⚠ DANGER

Shock hazard. Spark related components contain high voltage. Disconnect power before servicing.

For proper unit operation, electrodes must be positioned correctly in the flame and must be gapped correctly.

⚠ WARNING

The ignition control is not field repairable. Unsafe operation will result.

K-Spark Electrode/Flame Sensor Gap

The electrode assembly can be removed for inspection by removing two screws securing the electrode assembly and sliding it out of unit.

Spark gap may be checked with appropriately sized twist drills or feeler gauges. Disconnect power to the unit and remove electrode assembly. The gap should be between 0.094" and 0.156". See figure 25.

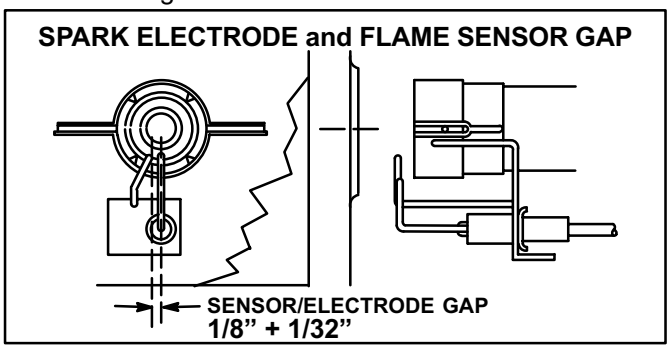


FIGURE 25

L-Flame Sensing

Flame current is an electrical current which passes from the ignition control through the sensor electrode during unit operation. The current passes from the sensor through the flame to ground electrode to complete a safety circuit. The minimum flame current necessary to keep the ignitor from lockout is 5 microamps. The electrodes should be located so the tips are at least 1/2" inside the flame envelope. Do not bend electrodes. To measure flame current, follow the procedure below:

⚠ DANGER

Electrodes are not field adjustable. Any alterations to the electrode may create a hazardous condition that can cause property damage or personal injury.

1- Disconnect power to unit.
2- Remove lead from sensing electrode and install a 0-50DC microamp meter in series between the sensing electrode and the sensing lead.
3- Reconnect power and adjust thermostat for heating demand.
4- When flame is established, meter reading should be 8 to 20 microamps. Do not bend electrodes.
5- Disconnect power to unit before disconnecting meter. Make sure sensor wire is securely reconnected before reconnecting power to unit.

NOTE-If the meter scale reads 0, the leads are reversed. Disconnect power and reconnect leads for proper polarity.

M-Combustion Air Blower

The combustion air blower and prove switch are factory set and are not field adjustable. However, operation should be monitored to ensure proper operation. The combustion air blower is used to draw fresh air into the combustion chamber while simultaneously expelling exhaust gases. The blower operates throughout the heating cycle. On a heating demand, the combustion air blower immediately energizes but the ignition control circuit does not. Once the combustion air blower is energized, the combustion air prove switch closes to energize the ignition control. The ignition control then begins attempting ignition after 30-40 seconds.

If the combustion air blower does not reach full speed the prove switch will not close and the ignition control will not energize. The unit will remain locked out until the problem is found and corrected.

XI-ACCESSORIES

This section describes the application of most of the optional accessories which can be connected to the GCS24. Some of the accessories (for example, the Warm Up Control Kit) are described in the commercial controls section of this manual.

A-RMF16 Mounting Frame

When installing a GCS24 unit on a combustible surface for downflow discharge applications, the Lennox RMF16 roof mounting (figure 26) frame is used. Otherwise, the RMF16 is recommended but not required. The GCS24, if not mounted on a flat (roof) surface, MUST be supported under all edges and under the middle of the unit to prevent sagging. The GCS24 MUST be mounted level within 1/16" per linear foot in any direction.

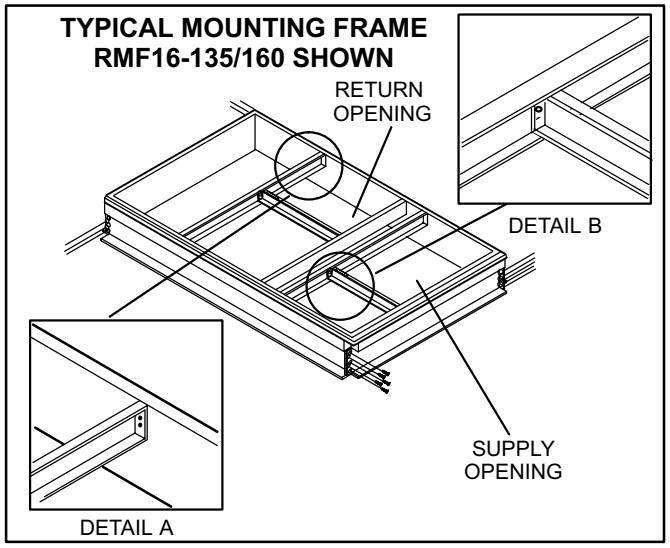


FIGURE 26

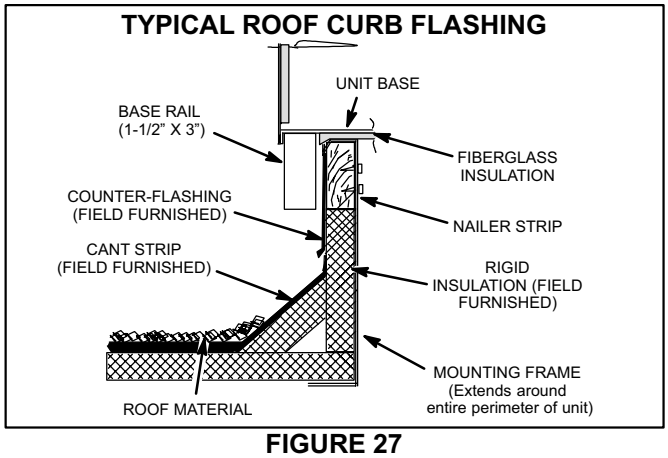


FIGURE 27

The assembled RMF16 mounting frame is shown in figure 26. Refer to the RMF16 installation instructions for details of proper assembly and mounting. The roof mounting frame MUST be squared to the roof before mounting. Plenum system MUST be installed before the unit is set on the mounting frame. Typical roof curbing and flashing is shown in figure 27. Refer to the RMF16 installation instructions for proper plenum construction and attachment.

B-OAD24 Outdoor Air Damper

OAD24 is a manual outdoor air damper section (figure 28) which installs in GCS24 to allow a fixed amount of outside air into the system. OAD24 consists of a set of manually operated dampers which may be adjusted and locked in place to allow up to 25 percent outside air into the system at all times. Automatic operation is available with addition of an electric spring-return three-position damper actuator. Refer to OAD24 installation instructions for specific installation procedure. Washable filter supplied with the OAD24 can be cleaned with water and a mild detergent. It should be sprayed with Filter Handicoater when dry prior to reinstallation. Filter Handicoater is R.P. Products coating no. 418 and is available as Lennox Part No. P-8-5069.

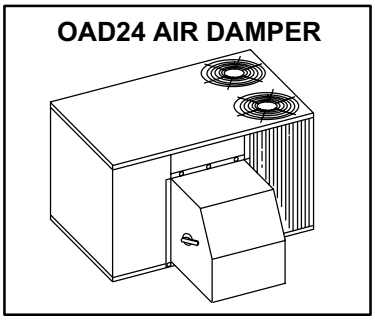


FIGURE 28

C-Economizer

Optional economizer dampers can be applied directly to GCS24. An economizer consists of a mechanically linked recirculated air and outdoor air damper assembly, an enthalpy sensor and damper motor installed in the economizer. An enthalpy control assembly is also furnished and may be installed in the filter access area of the unit or in the economizer (depending on model). An exhaust damper assembly installed in the economizer provides return air exhaust.

Several accessories are available and may be used with any economizer. Optional Warm Up Kit may be added to any economizer if electromechanical or simple electronic control thermostat is used with night setback. Warm Up Kit forces outdoor air dampers closed during initial morning warm up. Optional GED16 gravity exhaust dampers may be installed on any economizer to provide automatic pressure relief in return air duct. Optional differential enthalpy control may be added to any economizer to monitor both indoor and outdoor air conditions. With differential enthalpy installed, the economizer selects the lowest of the two enthalpy conditions to satisfy cooling demand.

1-REMD24M Downflow Economizer

The REMD24M economizer is designed for standard (downflow) use with GCS24 units. The REMD24M cannot be converted to horizontal discharge. The economizer monitors outdoor air conditions and opens the outdoor air dampers to allow 0 to 100 percent outdoor air to be used for cooling when outdoor humidity and temperature are acceptable. Damper position continually adjusts to outdoor conditions. Additional (second stage) cooling demand is shifted to the first stage compressor while the dampers remain open to provide first stage cooling. If outdoor air becomes unacceptable, the outdoor air dampers close to a predetermined minimum position while the compressor cooling circuit cycles as needed. First stage cooling is shifted back to the first stage compressor and second stage cooling is directed to the second stage compressor.

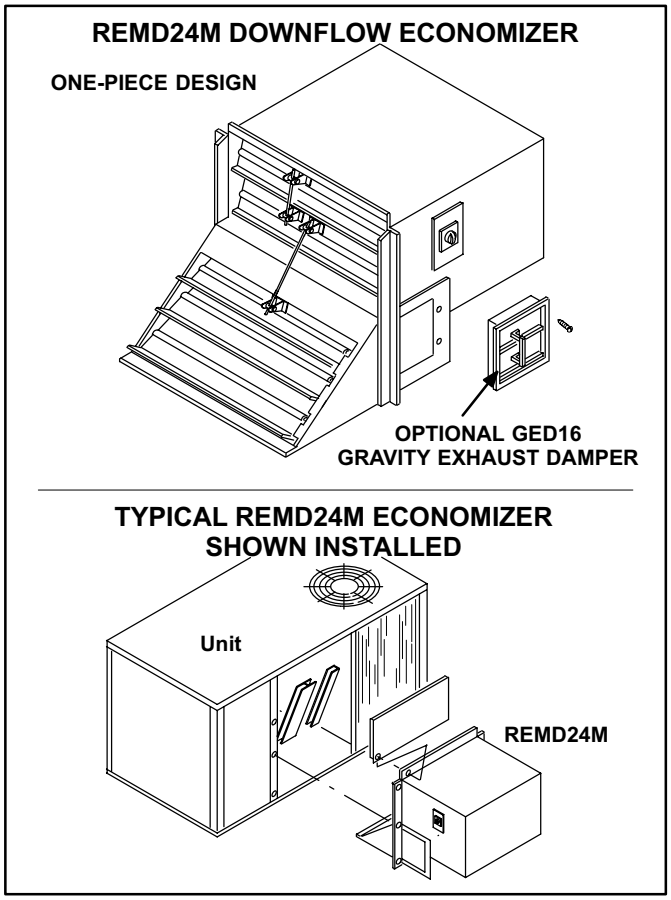


FIGURE 29

Refer to the REMD24M installation instruction for specific installation details. Refer to the operation sequence (in back of this manual) for detailed economizer operation. Operation sequence flowcharts also describe how the economizer interacts with the GCS24 and the control system being used.

2-Economizer Accessories

a-GED16 Gravity Exhaust Dampers

Optional GED16 gravity exhaust dampers may be connected to REMD24M economizers. Automatic exhaust dampers provide positive pressure relief in return air duct. See figure 29.

b-Warm Up Kit (units equipped with standard or electronic thermostat and night setback function)

An optional warm up kit may be added to the REMD24M economizer (except GCS24 units using a Honeywell W7400 control system). The warm up kit holds the dampers closed during night setback and morning warm up. When the first thermostat demand of the day is satisfied, the warm up kit opens the outdoor dampers to minimum position. The warm up kit installs in the GCS24 filter access section. The kit plugs into the unit wiring harness inline between the unit and the economizer. For detailed wiring and operation, refer to the sequence of operation section of this manual.

If a W973 system is used, the relay kit holds the outdoor dampers closed during setback. If an electromechanical thermostat system is used, the relay kit holds the outdoor dampers closed during setback, de-energizes the indoor thermostat and energizes the setback thermostat.

c-Differential Enthalpy (all economizers)

Optional differential enthalpy control may be added to any economizer to monitor both indoor and outdoor air conditions. With differential enthalpy installed, the economizer selects the lowest of the two enthalpy conditions to satisfy cooling demand.

When differential enthalpy is installed, the second enthalpy sensor is installed in the return air duct while the original enthalpy sensor remains installed on the outdoor air dampers.

Refer to the wiring diagram section of this manual for wiring.

3-Economizer Operation and Controls (all economizers)

a-Enthalpy Control: Control Setpoint

The key to economizer operation is the enthalpy control. The enthalpy control senses total heat content of outside air (temperature plus humidity) and uses that information to control the amount of outside air brought into the system. When the enthalpy of outside air drops below the control setpoint and cooling

demand is present, the control actuates a motor which in turn adjusts outdoor dampers to meet cooling demand. With outdoor air dampers open, the indoor blower draws in outdoor air for cooling and first stage compressors are disabled. When heat content rises above the setpoint, the control de-activates and the dampers close to the preset minimum position. First stage compressors are switched to handle all first stage cooling.

Two types of adjustment may be made at the control. The first is the control setpoint. The setpoint determines the temperature and humidity conditions at which the outdoor air dampers will open and close. The recommended setpoint is "A." If the economizer is allowing air which is too warm or too humid into the system, the control may be changed to a lower setpoint (B,C or D). Refer to enthalpy chart figure 30.

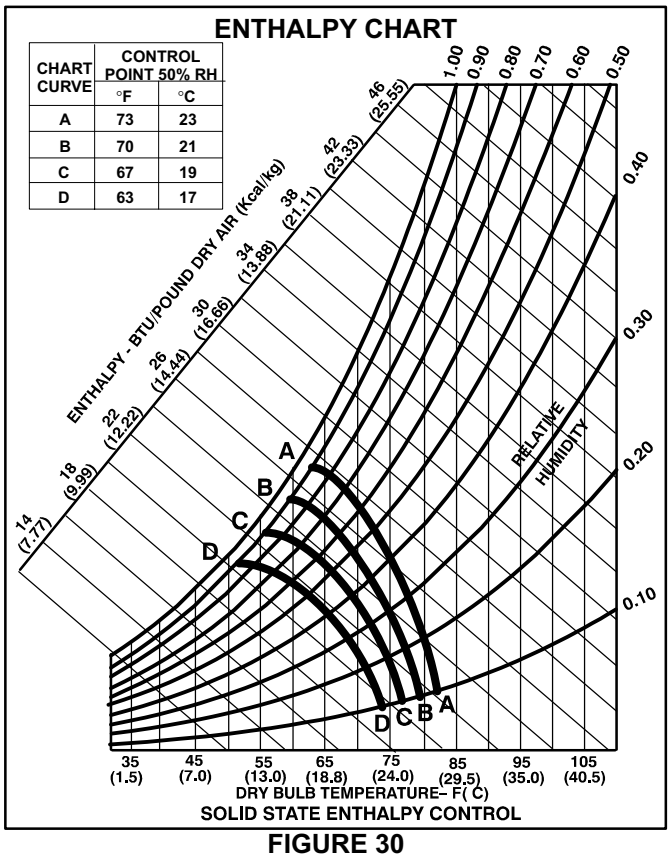


FIGURE 30

Example:

If the enthalpy control is set at setpoint "A" as shown in figure 30, the following situation could occur. A cooling demand when the outside air is at 75° and 20 percent humidity would drive the economizer outdoor air dampers open to utilize outdoor air for cooling. The compressor cooling circuit would be disabled. However, if the outdoor air should change to 70°F (a drop in temperature) and 70 percent humidity (a dramatic rise in humidity), the "total heat content" of the outdoor air would rise above the enthalpy control setpoint and deactivate the damper motor to the preset minimum position. If cooling demand is still present when the total heat of the outside air rises above the control setpoint, cooling demand is routed from the economizer to the compressor cooling circuit.

b-Minimum Positioner

The second type of adjustment which may be made at the control is the minimum position of the outdoor damper blades. Each economizer has a minimum positioner switch (potentiometer) which allows the outdoor dampers to be adjusted to a preset minimum position. This allows a preset amount of air exchange at all times during blower operation. When unit operation stops, the dampers drive closed. The potentiometer is located on the enthalpy control face.

c-Enthalpy Sensor

The enthalpy sensor is located on the outside portion of the outdoor damper blades. The sensor monitors the total heat content of the outdoor air (temperature plus humidity) and sends the information to the enthalpy control. The enthalpy control uses the information to determine if outdoor air can be used for cooling.

d-Mixed Air Sensor

The mixed air sensor measures the resultant temperature of the mixed air downstream from the evaporator coil. Temperature is measured in the heating compartment (figure 31). The mixed air temperature is used by the enthalpy control when outdoor dampers are open to help determine outdoor air damper position. The economizer is factory equipped with a single mixed air sensor which fits through a factory supplied hole in the panel dividing unit return and supply air (see figure 31).

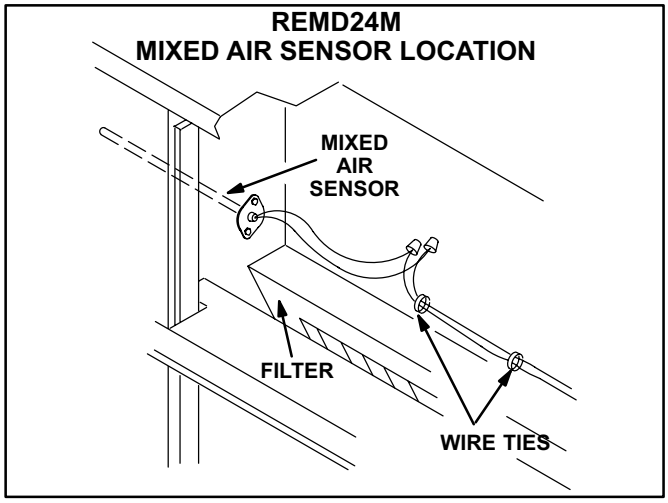


FIGURE 31

e-Wiring, Installation, Maintenance

The economizer uses harness plugs to connect to the GCS24 unit harness connector located in the filter access compartment. The 10 and 12.5 ton economizers are unitary in construction (all one piece). Although harness connectors are used to connect the GCS24 to the economizer, the economizer electrically connects to the GCS24 differently depending on which control system has been installed. The different electrical connections are made in relay kits and controls located in the filter access area of the unit. All connections (except for enthalpy sensor and mixed air sensor) are made with quick-connect type harness connectors. For specific details of economizer wiring and operation, refer to the sequence of operation section of this manual.

f-Modulating Damper Motor Check

The following procedure checks only the damper motor. For detailed economizer checkout procedure refer to Lennox' Solid State Economizer Checkout And Troubleshooting Guide.

1- Disconnect power. Turn thermostat to OFF position (occupied mode).

2- Install jumper across contactor K3-2 terminals (see unit diagram) in unit control box. Install jumper across enthalpy control terminals T and T1. See figure 32 for terminal location.

3- Restore power to unit. Outdoor damper should drive to fully open position (60 to 90 sec. required for full travel). Observe travel for proper damper operation.

4- Disconnect power to unit. Outdoor damper should spring return to closed position.

5- Remove T and T1 jumper then restore power to unit. Outdoor damper should drive to minimum position. Adjust minimum damper position pot located on control. See figure 32.

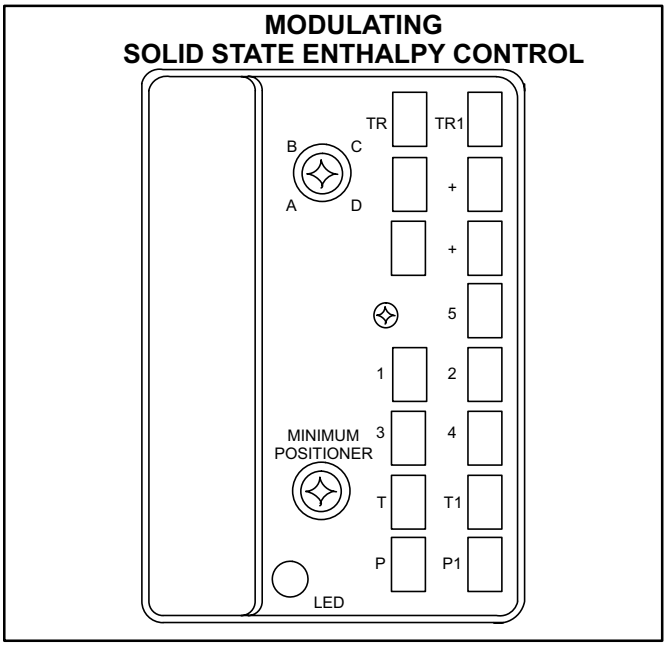


FIGURE 32

6- Disconnect power to unit and remove jumper on blower relay terminals 6-9. Replace all panels. Restore power to unit.

D-Transitions

Optional supply/return transition SRT16 is available for use with GCS24 series units utilizing optional RMF16 roof mounting frame. Transition must be installed in the RMF16 mounting frame before mounting the GCS24 to frame. Refer to the manufacturer's instructions included with the transition for detailed installation procedures.

E-Supply and Return Diffusers

Optional flush mount diffuser/return FD11 and extended mount diffuser/return RTD11 are available for use with the GCS24. Refer to manufacturer's instructions included with transition for detailed installation procedures.

F-Optional Cold Weather Kit (Canada only)

Electric heater is available to automatically control the minimum temperature in the gas burner compartment. Heater is C.G.A. certified to allow cold weather operation of unit down to -60°F (-50°C).

The kit includes the following parts:

1- Transformer (T20) is a 600V to 120/240V stepdown transformer mounted in the blower compartment.

2- T20 has two in line fuses (F20), one on each leg of the transformer. Both are rated at 15 amps.

3- The strip heater (HR6) is located as close as possible to the gas valve. It is wired in series with T20. The strip heater is rated at 500 Watts

4- A thermostat mounting box is installed on the vestibule of the heating compartment. Included in the box are the following thermostat switches:

a - Thermostat switch (S59) is an auto-reset SPST N.C. switch which opens on a temperature drop. The switch is wired in series with 24v power and the combustion air blower switch. When the temperature drops below -20°F the switch opens and the gas heat section is de-energized. The switch automatically resets when the heating compartment temperature reaches 10°F.

b - Thermostat switch (S60) is an auto-reset SPST N.C. switch which opens on a temperature rise. The switch is wired in series with HR6 and T20. When the temperature rises above 20°F the switch opens and the electric heater is de-energized. The switch automatically resets when the heating compartment temperature reaches -10°F.

b - Thermostat switch (S61) is an auto-reset SPST N.O. switch which closes on a temperature drop. The switch is wired in series with HR6 and T20. When temperature drops below 20°F the switch closes and electric heater is energized. The switch automatically opens when heating compartment temperature reaches 50°F.

G-Firestats S74 and S75

Some local codes require the installation of discharge air and return air firestats to automatically shut down the unit when excessive temperature is reached . Other local codes require firestats wired to perform tasks such as energizing a blower or closing dampers. These field provided firestats MUST be mounted and wired per local codes or insuring agencies. If manual reset controls are used, they MUST be accessible.

Smoke Detector wiring is shown on the unit wiring digrams in back of this manual.

H-Cycle Control Kit (Figure 33)

Optional cycle control kit, when applied to GCS24 unit with electromechanical thermostat, prevents frequent cycling caused by thermostat diddling or thermostat bulb vibration. The cycle controls require minimum on and minimum off times before compressors can be energized or de-energized. The cycle controls plug-into the J16/P16 jackplug located in the unit filter section. No field wiring is required. The kit consists of two cycle control delays DL8 and DL9. Once installed, DL8 prevents the first stage compressors from being energized until the first stage thermostat bulb has been closed for at least 30 seconds. First stage thermostat bulb must be open for at least 240 seconds before first stage compressors can be de-energized. DL9 prevents second stage compressors from being energized until second stage thermostat bulb has been closed for at least 60 seconds. Second stage thermostat bulb must be open for at least 240 seconds before second stage compressors can be de-energized.

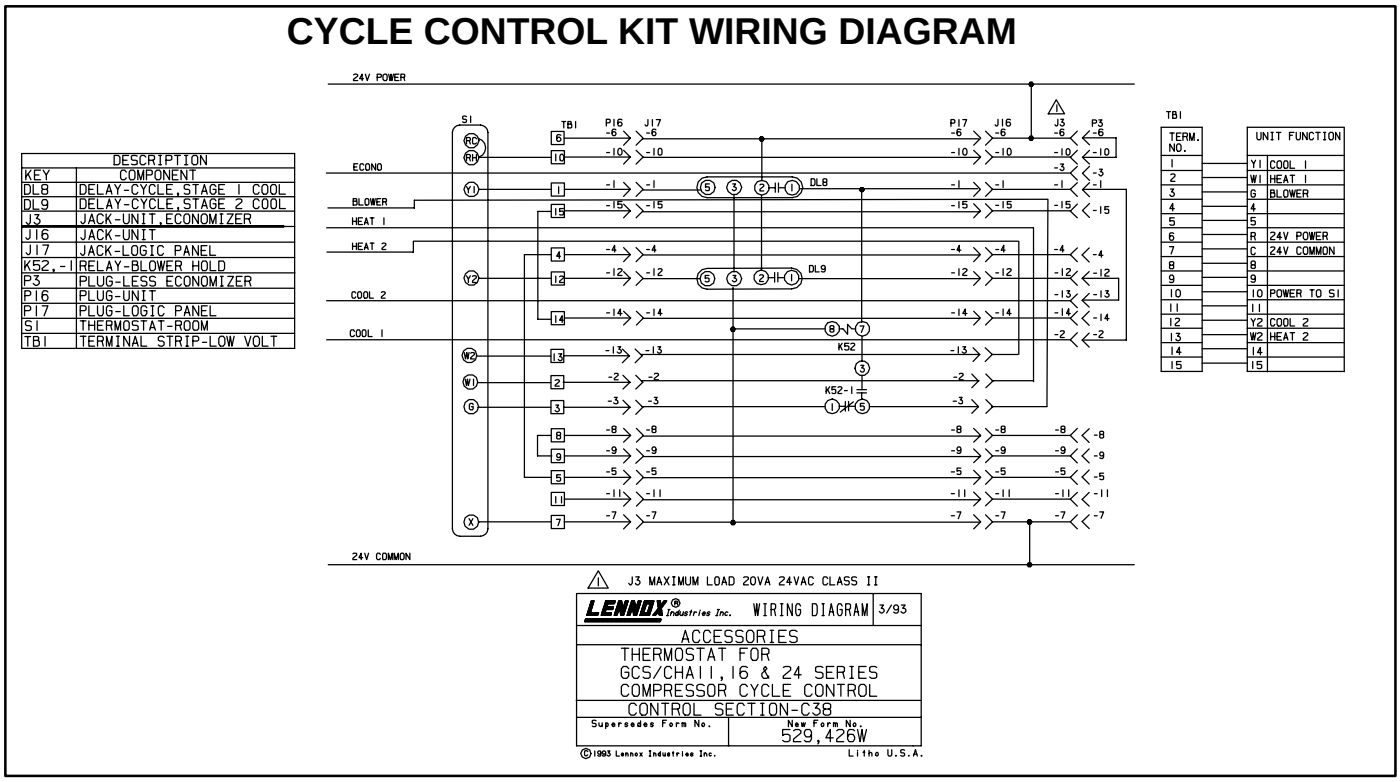


FIGURE 33

I-Status Panels SP11 and SSP11

Optional status panels allow remote monitoring of system operation. Two types of panels are available. See figure 34. The SP11 provides system readout only. The SSP11 switching status panel is a combination switching subbase and system readout. The SSP11 also has an “After Hours Timer” to override the unoccupied mode (night heating setback / cooling setup).

1-SP11 Application

The SP11 may be applied to any GCS24 control system. To operate an SP11, a readout relay kit is required to interface the GCS24 to the SSP11. Optional filter switch kit must be added in order to make the filter light functional.

2-SSP11 Application

The SSP11 may be applied to GCS24 units using standard electromechanical thermostat or Honeywell W973 control systems only. The W7400 and T7300 control systems provide switching features similar to the SSP11, therefore, the SSP11 is not needed. To operate an SSP11, a readout relay kit is required to interface the GCS24 to the SSP11. An SSP11 relay kit is also required (in addition to the readout relay kit and current sensing relay) in units using an electromechanical thermostat.

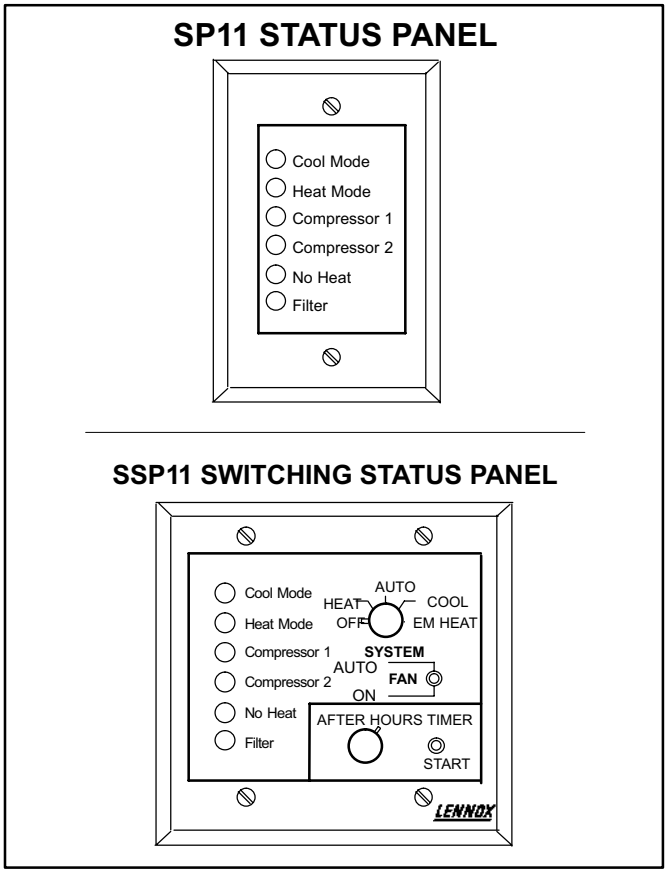


FIGURE 34

Optional filter switch kit is required to make the filter light functional.

J-Commercial Controls Hardware

All GCS24 units are factory equipped with the hardware required to connect and operate Lennox' Commercial Controls (W973, W7400, economizer, warm-up, etc...). The hardware consists of an economizer wiring harness, a control system wiring harness and associated jackplugs. The economizer and control harnesses are pre-wired to facilitate economizer, controls and/or warm-up connections.

Each unit is equipped with marked jackplugs at various locations throughout the unit. Each jack is marked with a "J" number on the jack (for example J5) and a corresponding "P" number on the plug (for example P5). The J16/P16 jackplug and the J3/P3 jackplug are used as connection points for commercial control systems in all Lennox commercial equipment. Lennox supplied control systems are pre-wired with plugs which match the corresponding jackplugs in the unit.

Following is a list of important jackplugs found in Lennox 10 and 12.5 ton commercial equipment and the function of each:

1 - *Jack J3 / Plug P3*

Jack J3 is located in the unit filter section of all units. It is wired to the unit wiring harness and is used for the connection of an economizer or any of the relay kits which are used to interface optional controls to the unit.

The mating **plug P3** is a jumper plug which is necessary to complete circuits internal to the unit when the unit is operated without accessories. When the unit is operated with accessories, P3 is removed and discarded.

2 - *Jack J16 / Plug P16*

Jackplug J16/P16 is located in the unit control box . Jackplug J16/P16 is used exclusively as a connection point for the control portion of optional control systems. Plug P16 is wired to the unit low voltage terminal strip and jack J16 is wired to the unit wiring harness.

3 - *Jack J35 / Plug P35*

Jackplug J35/P35 located in the unit control box is used for assembly line tests only. J35/P35 is not used for the connection of any control or control system.

K-Optional Commercial Controls Systems

Optional "24 Series Commercial Controls" may be connected to both the 10 and 12.5 GCS24 units. These are the same controls which are optional in all 24 series commercial units. The following list describes the components used in all currently available (at time of printing) optional control system combinations. Each system is assigned a "C" number for easy reference. The "C" number identifies the control system on the wiring diagram (likewise, each GCS24 unit wiring diagram is assigned a "B" number, each heating section is assigned an "A" number and each economizer diagram is assigned a "D" number). Look for these numbers on the diagram to help you identify how the unit is set up and which control system is being used.

The control system wiring diagrams and the accompanying system "Operation Sequences" are not included in this manual.

The following section is provided to help service personnel become familiar with Lennox' Commercial Controls and the associated wiring schemes.

1 - *D5 Wiring Diagram - Modulating Economizer Model Number REMD24M-160*

Downflow Modulating Economizer. Optional field installed in all GCS24 units. Sensors continuously monitor air conditions and adjust dampers accordingly. Modulating economizer provides an infinite number of damper positions.

All wiring connections are made by jackplug connections to the commercial controls harness in the unit. **Plug P4** in the economizer connects to Jack J3 in the unit to make this connection.

2 - *Warm-Up Kit*

Warm-up kit is shown in Figure 35 . Warm-up kit is an accessory to the economizer (diagram D5).

The kit provides warm-up capabilities by holding outdoor air dampers closed during the first heating period after night setback. When first heating demand is satisfied, warm-up kit allows outdoor air dampers to open to minimum position.

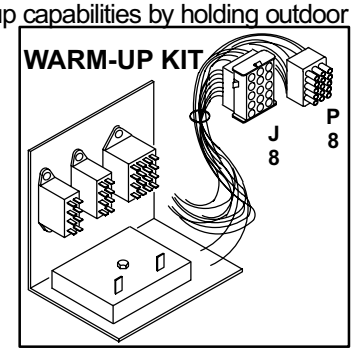


FIGURE 35

Warm-up kit does not have its own wiring diagram. It is included in the C2, C4, C6 and C14 wiring diagrams.

All wiring connections are made by jackplug connections to the commercial controls harness in the unit. See figure 36. **Plug P8** in the warm up kit connects to Jack J3 in the unit to make this connection. **Jack J8** in the warm up kit connects to Plug P4 in the economizer. Thermostat wiring connections are made to the unit low voltage terminal strip.

Some of the following optional thermostat control systems have built-in warm up capabilities and the warm up kit (figure 35) cannot be added due to wiring incompatibility.

The warm-up kit is an option to the REMD24M economizer. The warm-up kit may be applied to any economizer (except units using W7400 control system or T7300 control system). If W973 control system is being used, CMC3-1 time clock must also be used. If electromechanical control system is being used, CMC3-1 time clock and night thermostat must be used.

⚠ CAUTION

Do not connect a warm-up kit to a W7400 relay kit or to a system using a T7300. Warm-up kit wiring is not compatible with these control systems and component damage will result. These control systems have a warm-up feature built in. A warm-up kit is not needed.

An economizer allows outside air to be used for cooling when conditions are acceptable and permits a preset amount of air exchange during all other unit operation. Warm-up kit holds outdoor air dampers full closed during first heating demand after night setback (during morning warm-up).

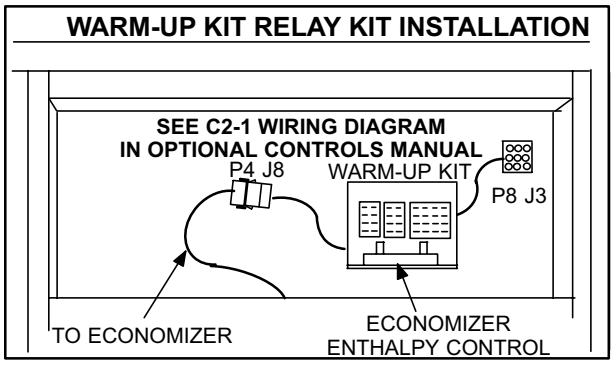


FIGURE 36

No wiring is required (see figure 36). The kit plugs into the unit wiring harness between the unit and economizer. Unit plug P3 is removed and discarded. Relay kit plug P8 connects to unit jack J3. Relay kit jack J8 connects to economizer plug P4.

3 - *C1 Wiring Diagram*
Standard 2heat/2cool thermostat for all units without economizer or warm-up. All wiring connections are made to the unit low voltage terminal strip.

4 - *C2-1 Wiring Diagram*
Standard 2heat/2cool thermostat for all units with economizer and warm-up. CMC3-1 clock and night thermostat must be added for night setback. Night relay must also be added to economizer for night setback. The warm up kit "plugs-in" to the unit with **plug P8**. Warm up kit **jack J8** connects to unit jumper plug P3 or economizer plug P4. The thermostat connects to the unit's low voltage terminal strip.

5 - C11-1 *Wiring Diagram*
Standard 2heat/2cool thermostat for all units without economizer or warm-up. C11 Night Kit adds a relay facilitating night setback function (see figure 37). CMC3-1 clock and night thermostat must also be added to make setback relay functional.

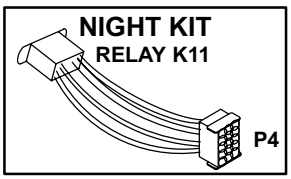


FIGURE 37

⚠ WARNING

Connect only relay kits designed for this control system. Relay kits designed for other control systems are not compatible and control damage or failure will result. For example, do not connect a warm-up kit to this control system.

All wiring connections are made by jackplug connections to the commercial controls harness in unit (see figure 38). **Plug P4** in the economizer connects to Jack J3 in the unit to make connection.

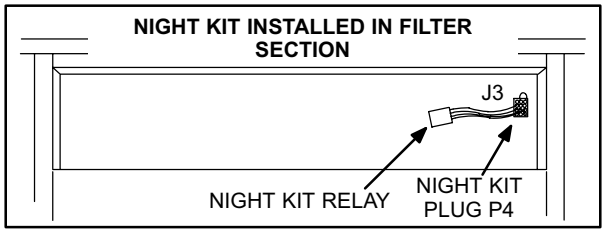
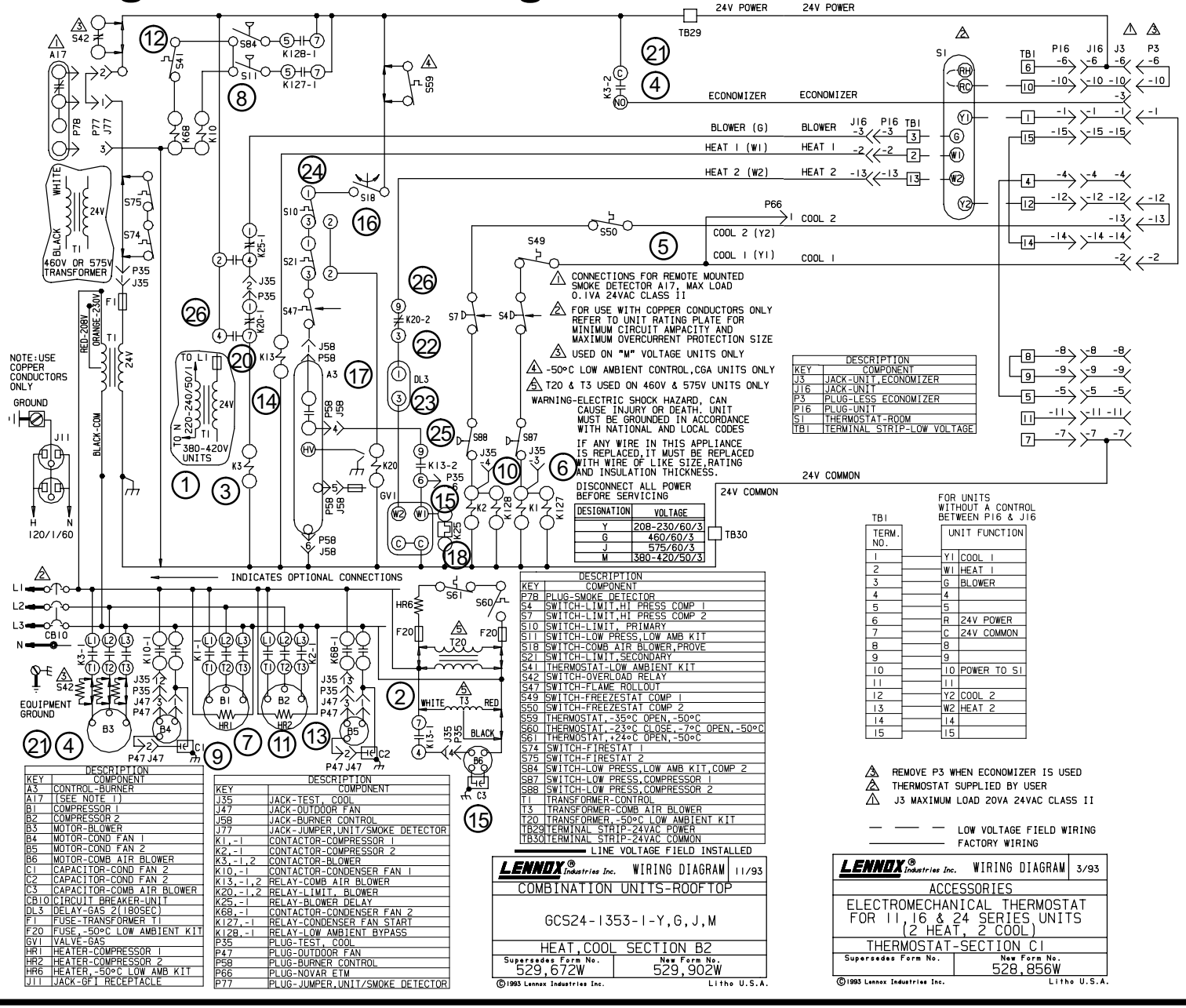


FIGURE 38

Night (setback relay) kit allows GCS24 units without REMD24M economizer to automatically "set back" the thermostat to reduce energy consumption during times when the building is not occupied. The night kit achieves this by disconnecting thermostat S1 and connecting a night thermostat during periods when the building is not occupied. The night thermostat can then be adjusted with a lower setpoint as needed for unoccupied heating.

B2 diagram with C1 diagram *GCS24-1353 with basic standard thermostat*



DESCRIPTION	
KEY	COMPONENT
J3	JACK-UNIT,ECONOMIZER
J16	JACK-UNIT
P3	PLUG-LESS ECONOMIZER
P16	PLUG-UNIT
S1	THERMOSTAT-ROOM
TB1	TERMINAL STRIP-LOW VOLTAGE

DESIGNATION	VOLTAGE
Y	208-230/60/3
G	460/60/3
J	575/60/3
M	380-420/50/3

TB1 TERM. NO.	UNIT FUNCTION	
1	Y1	COOL 1
2	W1	HEAT 1
3	G	BLOWER
4	4	
5	5	
6	R	24V POWER
7	C	24V COMMON
8	8	
9	9	
10	10	POWER TO S1
11	11	
12	Y2	COOL 2
13	W2	HEAT 2
14	14	
15	15	

DESCRIPTION	
KEY	COMPONENT
A3	CONTROL-BURNER
A17	(SEE NOTE 1)
B1	COMPRESSOR 1
B2	COMPRESSOR 2
B3	MOTOR-BLOWER
B4	MOTOR-COND FAN 1
B5	MOTOR-COND FAN 2
B6	MOTOR-COMB AIR BLOWER
C1	CAPACITOR-COND FAN 2
C2	CAPACITOR-COND FAN 2
C3	CAPACITOR-COMB AIR BLOWER
CB10	CIRCUIT BREAKER-UNIT
DL3	DELAY-GAS 2(180SEC)
F1	FUSE-TRANSFORMER T1
F20	FUSE,-50°C LOW AMBIENT KIT
GV1	VALVE-GAS
HR1	HEATER-COMPRESSOR 1
HR2	HEATER-COMPRESSOR 2
HR6	HEATER,-50°C LOW AMB KIT
J11	JACK-GFI RECEPTACLE

DESCRIPTION	
KEY	COMPONENT
J35	JACK-TEST, COOL
J47	JACK-OUTDOOR FAN
J58	JACK-BURNER CONTROL
J77	JACK-JUMPER,UNIT/SMOKE DETECTOR
K1,-1	CONTACTOR-COMPRESSOR 1
K2,-1	CONTACTOR-COMPRESSOR 2
K3,-1,2	CONTACTOR-BLOWER
K10,-1	CONTACTOR-CONDENSER FAN 1
K13,-1,2	RELAY-COMB AIR BLOWER
K20,-1,2	RELAY-LIMIT, BLOWER
K25,-1	RELAY-BLOWER DELAY
K68,-1	CONTACTOR-CONDENSER FAN 2
K127,-1	RELAY-CONDENSER FAN START
K128,-1	RELAY-LOW AMBIENT BYPASS
P35	PLUG-TEST, COOL
P47	PLUG-OUTDOOR FAN
P58	PLUG-BURNER CONTROL
P66	PLUG-NOVAR ETM
P77	PLUG-JUMPER,UNIT/SMOKE DETECTOR

DESCRIPTION	
KEY	COMPONENT
P78	PLUG-SMOKE DETECTOR
S4	SWITCH-LIMIT,HI PRESS COMP 1
S7	SWITCH-LIMIT,HI PRESS COMP 2
S10	SWITCH-LIMIT, PRIMARY
S11	SWITCH-LOW PRESS,LOW AMB KIT
S18	SWITCH-COMB AIR BLOWER,PROVE
S21	SWITCH-LIMIT,SECONDARY
S41	THERMOSTAT-LOW AMBIENT KIT
S42	SWITCH-OVERLOAD RELAY
S47	SWITCH-FLAME ROLLOUT
S49	SWITCH-FREEZESTAT COMP 1
S50	SWITCH-FREEZESTAT COMP 2
S59	THERMOSTAT,-35°C OPEN,-50°C
S60	THERMOSTAT,-23°C CLOSE,-7°C OPEN,-50°C
S61	THERMOSTAT,+24°C OPEN,-50°C
S74	SWITCH-FIRESTAT 1
S75	SWITCH-FIRESTAT 2
S84	SWITCH-LOW PRESS,LOW AMB KIT,COMP 2
S87	SWITCH-LOW PRESS,COMPRESSOR 1
S88	SWITCH-LOW PRESS,COMPRESSOR 2
T1	TRANSFORMER-CONTROL
T3	TRANSFORMER-COMB AIR BLOWER
T20	TRANSFORMER,-50°C LOW AMBIENT KIT
TB29	TERMINAL STRIP-24VAC POWER
TB30	TERMINAL STRIP-24VAC COMMON

LENNOX Industries Inc.	WIRING DIAGRAM	11/93
COMBINATION UNITS-ROOFTOP		
GCS24-1353-1-Y,G,J,M		
HEAT,COOL SECTION B2		
Supersedes Form No. 529,672W	New Form No. 529,902W	

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LENNOX Industries Inc.	WIRING DIAGRAM	3/93
ACCESSORIES		
ELECTROMECHANICAL THERMOSTAT FOR 11,16 & 24 SERIES UNITS (2 HEAT, 2 COOL)		
THERMOSTAT-SECTION C1		
Supersedes Form No.	New Form No. 528,856W	

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C1 DIAGRAM WITH B2 DIAGRAM

Electromechanical Thermostat Connected to GCS24-1353 (Without Economizer)

Operation Sequence: C1 and B2 Sections (electromechanical thermostat wired to GCS24-1353)

Power:

1- When the unit disconnect closes, line voltage energizes transformer T1 and the compressor crankcase heaters. Transformer T1 provides 24VAC power to unit cooling, heating and blower controls and thermostat. The crankcase heaters are powered at all times but are self-regulating

2- Transformer T3 (460V and 575V units) is also energized when power is applied to the unit.

Blower Operation:

3- Blower demand from thermostat terminal G energizes blower contactor K3.

4- N.O. K3-1 closes, blower begins operation. N.O. K3-2 closes energizing economizer damper motor (if economizer is installed, outdoor damper drives to minimum position).

1st Stage Cooling (both compressors B1 and B2 operate separately):

5- Cooling demand energizes Y1 and G in the thermostat. G energizes blower (see step 3.)

6- 24VAC power is routed through N.C. freezestat S49, N.C. high pressure limit S4 and N.C. low pressure limit S87 to energize compressor contactor K1 and pilot relay K27.

7- N.O. Contacts K1-1 close energizing compressor B1.

8- N.O. pilot relay K127-1 closes allowing 24VAC to pass through the N.O. low ambient switch S11 to energize condenser fan contactor K10.

9- N.O. Contacts K10-1 close energizing condenser fan B4.

2nd Stage Cooling:

10- Second stage cooling demand energizes Y2. 24VAC power is routed through freezestat switch S50, high pressure limit S7 and low pressure limit S88 energizing compressor contactor K2 and pilot relay K128.

11- N.O. contacts K2-1 close energizing compressor B2.

12- N.O. pilot relay K128-1 closes allowing 24VAC to pass through the N.O. low ambient switch S84 and N.C. low ambient thermostat S41 to energize condenser fan contactor K68.

13- N.O. Contacts K68-1 close energizing condenser fan B5.

1st Stage Heating:

14- On a call for first stage heating (W1), demand energizes combustion air blower relay K13.

15- When contacts K13-1 close, combustion air blower B6 is energized and immediately begins operating. When contactst K13-2 close, the gas valve is enabled.

16- As the combustion air blower approaches full speed, combustion air blower prove switch (S18) closes.

17- When S18 closes a 24VAC circuit is completed through the heating safety switches to energize burner ignition control A3.

18- When ignition control A3 determines that ignition can begin, A3 simultaneously sends 24VAC to the first stage operator of the gas valve and to the indoor blower delay relay (K25) and also sends spark to the spark electrode. The gas valve immediately opens and blower delay K25 immediately begins timing.

19- When flame is sensed by the ignition control, spark is stopped and the gas valve remains open. If flame is not sensed within the time allowed, spark is stopped, the gas valve is closed and the ignition control begins its retrial timing sequence.

20- When blower delay K25 ends its timing period, K25-1 switches. A 24VAC circuit is completed through K20-1 to energize blower contactor K3.

21- When contacts K3-1 close, the indoor blower is energized immediately begins operating. When K3-2 closes, a circuit is completed to the optional economizer to open the outdoor air dampers to minimum position.

2nd Stage Heating:

22- On a call for increased heating (W2), demand passes through K20-2 to energize time delay DL3. DL3 immediately begins its timing sequence.

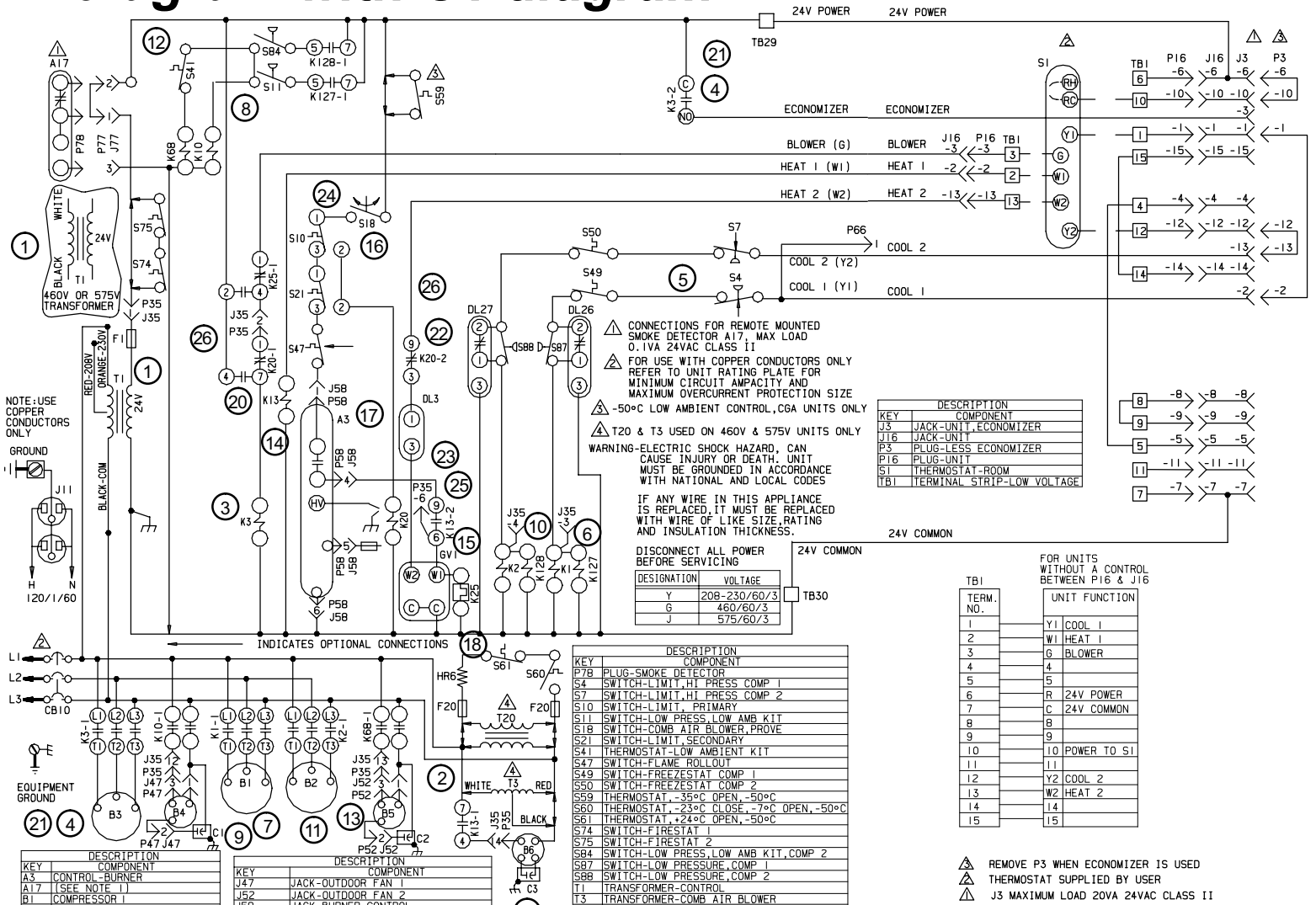
23- When DL3 time delay has elapsed, DL3 closes internally to complete a circuit to the second stage operator of the gas valve (W2). When gas valve operator W2 is energized, the gas valve begins to slowly open for second stage operation.

24- If either heating limit S10 or S21 open during heating operation, ignition control A3 is immediately de-energized and limit relay K20 is immediately energized.

25- When A3 is de-energized, the gas valve (W1) and blower delay (K25) are both de-energized.

26- When K20-1 switches, blower contactor K3 is energized to continue blower operation during the time that safety limits are open. When K20-2 opens, second stage thermostat demand is prevented from reaching the second stage operator of the gas valve (W2).

B2 diagram with C1 diagram GCS24-1603 with basic thermostat



DESCRIPTION	
KEY	COMPONENT
J3	JACK-UNIT,ECONOMIZER
J16	JACK-UNIT
P3	PLUG-LESS ECONOMIZER
P16	PLUG-UNIT
SI	THERMOSTAT-ROOM
TBI	TERMINAL STRIP-LOW VOLTAGE

DESCRIPTION	
KEY	COMPONENT
A3	CONTROL-BURNER
A17	(SEE NOTE 1)
B1	COMPRESSOR 1
B2	COMPRESSOR 2
B3	MOTOR-BLOWER
B4	MOTOR-COND FAN 1
B5	MOTOR-COND FAN 2
B6	MOTOR-COMB AIR BLOWER
C1	CAPACITOR-COND FAN 2
C2	CAPACITOR-COND FAN 2
C3	CAPACITOR-COMB AIR BLOWER
CB10	CIRCUIT BREAKER-UNIT
DL3	DELAY-GAS 2(180SEC)
DL26	DELAY-SHUNT,12 MIN
DL27	DELAY-SHUNT,12 MIN
F1	FUSE-TRANSFORMER T1
F20	FUSE,-50°C LOW AMBIENT KIT
GV1	VALVE-GAS
HR6	HEATER,-50°C LOW AMB KIT
J11	JACK-GFI RECEPTACLE
J35	JACK-TEST, COOL

DESCRIPTION	
KEY	COMPONENT
J47	JACK-OUTDOOR FAN 1
J52	JACK-OUTDOOR FAN 2
J58	JACK-BURNER CONTROL
J77	JACK-JUMPER,UNIT/SMOKE DETECTOR
K1,-1	CONTACTOR-COMPRESSOR 1
K2,-1	CONTACTOR-COMPRESSOR 2
K3,-1,2	CONTACTOR-BLOWER
K10,-1	CONTACTOR-CONDENSER FAN 1
K13,-1,2	RELAY-COMB AIR BLOWER
K20,-1,2	RELAY-LIMIT, BLOWER
K25,-1	RELAY-BLOWER DELAY
K68,-1	CONTACTOR-CONDENSER FAN 2
K127,-1	RELAY-CONDENSER FAN START
K128,-1	RELAY-LOW AMBIENT BYPASS
P35	PLUG-TEST, COOL
P47	PLUG-OUTDOOR FAN 1
P52	PLUG-OUTDOOR FAN 2
P58	PLUG-BURNER CONTROL
P66	PLUG-NOVAR ETM
P77	PLUG-JUMPER,UNIT/SMOKE DETECTOR

DESCRIPTION	
KEY	COMPONENT
P78	PLUG-SMOKE DETECTOR
S4	SWITCH-LIMIT,HI PRESS COMP 1
S7	SWITCH-LIMIT,HI PRESS COMP 2
S10	SWITCH-LIMIT, PRIMARY
S11	SWITCH-LOW PRESS,LOW AMB KIT
S18	SWITCH-COMB AIR BLOWER,PROVE
S21	SWITCH-LIMIT,SECONDARY
S41	THERMOSTAT-LOW AMBIENT KIT
S47	SWITCH-FLAME ROLLOUT
S49	SWITCH-FREEZESTAT COMP 1
S50	SWITCH-FREEZESTAT COMP 2
S59	THERMOSTAT,-35°C OPEN,-50°C
S60	THERMOSTAT,-23°C CLOSE,-7°C OPEN,-50°C
S61	THERMOSTAT,+24°C OPEN,-50°C
S74	SWITCH-FIRESTAT 1
S75	SWITCH-FIRESTAT 2
S84	SWITCH-LOW PRESS,LOW AMB KIT,COMP 2
S87	SWITCH-LOW PRESSURE,COMP 1
S88	SWITCH-LOW PRESSURE,COMP 2
T1	TRANSFORMER-CONTROL
T3	TRANSFORMER-COMB AIR BLOWER
T20	TRANSFORMER,-50°C LOW AMBIENT KIT
TB29	TERMINAL STRIP-24VAC POWER
TB30	TERMINAL STRIP-24VAC COMMON

LENNOX Industries Inc. WIRING DIAGRAM 9/93

COMBINATION UNITS-ROOFTOP

GCS24-1603-1-Y,G,J

HEAT,COOL SECTION B2

Supersedes Form No.	New Form No.
529,807W	529,905W

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LENNOX Industries Inc. WIRING DIAGRAM 3/93

ACCESSORIES

ELECTROMECHANICAL THERMOSTAT FOR 11,16 & 24 SERIES UNITS (2 HEAT, 2 COOL)

THERMOSTAT-SECTION C1

Supersedes Form No.	New Form No.
	528,856W

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C1 DIAGRAM WITH B2 DIAGRAM

Electromechanical Thermostat Connected to GCS24-1603 (Without Economizer)

Operation Sequence: C1 and B2 Sections (electromechanical thermostat wired to GCS24-1603)

Power:

1- When the unit disconnect closes, line voltage energizes transformer T1 and the compressor crankcase heaters. Transformer T1 provides 24VAC power to unit cooling, heating and blower controls and thermostat. The crankcase heaters are powered at all times but are self-regulating

2- Transformer T3 (460V and 575V units) is also energized when power is applied to the unit.

Blower Operation:

3- Blower demand from thermostat terminal G energizes blower contactor K3.

4- N.O. K3-1 closes, blower begins operation. N.O. K3-2 closes energizing economizer damper motor (if economizer is installed, outdoor damper drives to minimum position).

1st Stage Cooling (both compressors B1 and B2 operate separately):

5- Cooling demand energizes Y1 and G in the thermostat. G energizes blower (see step 3.)

6- 24VAC power is routed through N.C. high pressure limit S4, N.C. freezestat S49 and N.C. low pressure limit S87, and 12 minute delay shunt DL26 to energize compressor contactor K1 and pilot relay K27.

7- N.O. Contacts K1-1 close energizing compressor B1.

8- N.O. pilot relay K127-1 closes allowing 24VAC to pass through the N.O. low ambient switch S11 to energize condenser fan contactor K10.

9- N.O. Contacts K10-1 close energizing condenser fan B4.

2nd Stage Cooling:

10- Second stage cooling demand energizes Y2. 24VAC power is routed through high pressure limit S7, freezestat switch S50, low pressure limit S88, and 12 minute delay shunt DL27 energizing compressor contactor K2 and pilot relay K128.

11- N.O. contacts K2-1 close energizing compressor B2.

12- N.O. pilot relay K128-1 closes allowing 24VAC to pass through the N.O. low ambient switch S84 and N.C. low ambient thermostat S41 to energize condenser fan contactor K68.

13- N.O. Contacts K68-1 close energizing condenser fan B5.

1st Stage Heating:

14- On a call for first stage heating (W1), demand energizes combustion air blower relay K13.

15- When contacts K13-1 close, combustion air blower B6 is energized and immediately begins operating. When contactst K13-2 close, the gas valve is enabled.

16- As the combustion air blower approaches full speed, combustion air blower prove switch (S18) closes.

17- When S18 closes a 24VAC circuit is completed through the heating safety switches to energize burner ignition control A3.

18- When ignition control A3 determines that ignition can begin, A3 simultaneously sends 24VAC to the first stage operator of the gas valve and to the indoor blower delay relay (K25) and also sends spark to the spark electrode. The gas valve immediately opens and blower delay K25 immediately begins timing.

19- When flame is sensed by the ignition control, spark is stopped and the gas valve remains open. If flame is not sensed within the time allowed, spark is stopped, the gas valve is closed and the ignition control begins its retrial timing sequence.

20- When blower delay K25 ends its timing period, K25-1 switches. A 24VAC circuit is completed through K20-1 to energize blower contactor K3.

21- When contacts K3-1 close, the indoor blower is energized immediately begins operating. When K3-2 closes, a circuit is completed to the optional economizer to open the outdoor air dampers to minimum position.

2nd Stage Heating:

22- On a call for increased heating (W2), demand passes through K20-2 to energize time delay DL3. DL3 immediately begins its timing sequence.

23- When DL3 time delay has elapsed, DL3 closes internally to complete a circuit to the second stage operator of the gas valve (W2). When gas valve operator W2 is energized, the gas valve begins to slowly open for second stage operation.

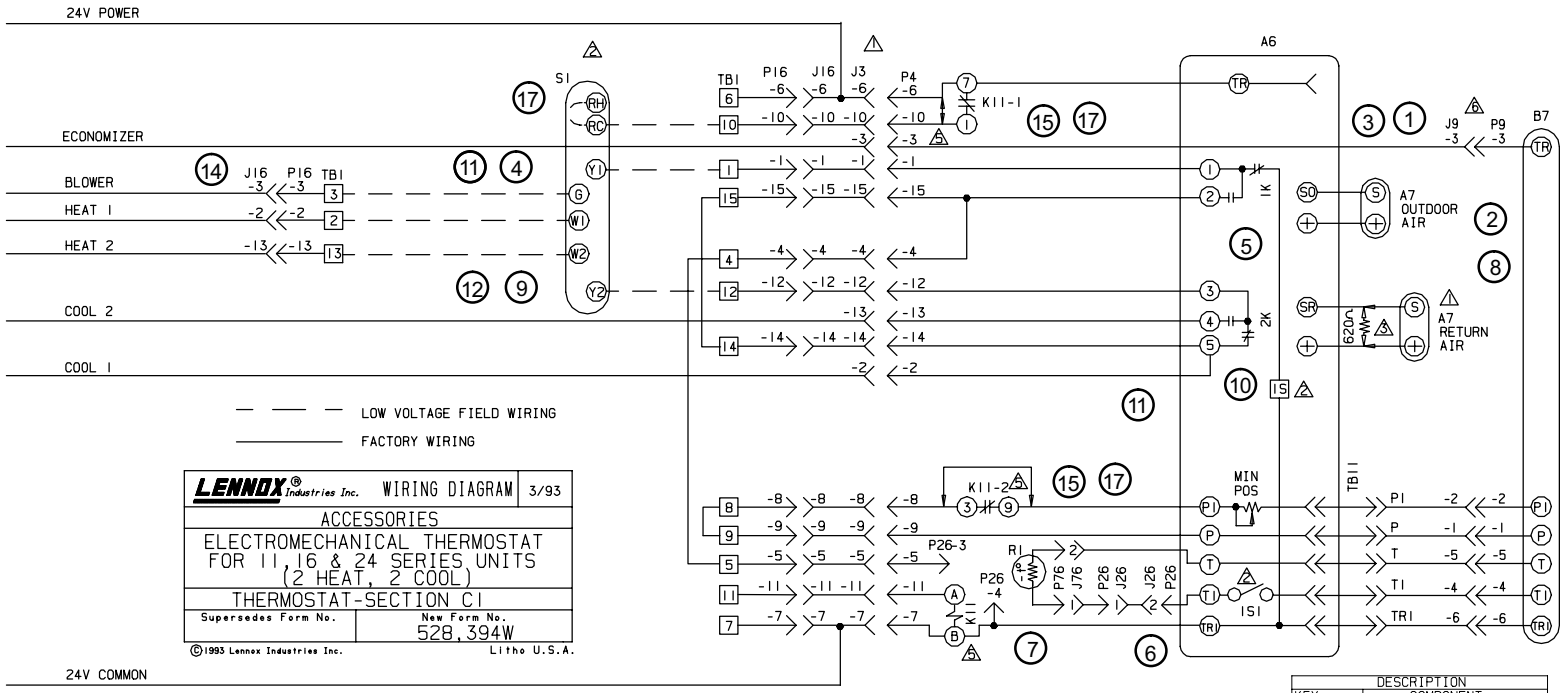
24- If either heating limit S10 or S21 open during heating operation, ignition control A3 is immediately de-energized and limit relay K20 is immediately energized.

25- When A3 is de-energized, the gas valve (W1) and blower delay (K25) are both de-energized.

26- When K20-1 switches, blower contactor K3 is energized to continue blower operation during the time that safety limits are open. When K20-2 opens, second stage thermostat demand is prevented from reaching the second stage operator of the gas valve (W2).

C1 diagram with D5 diagram

electromechanical thermostat with modulating economizer



LENNOX® Industries Inc.	WIRING DIAGRAM	3/93
ACCESSORIES		
ELECTROMECHANICAL THERMOSTAT FOR 11,16 & 24 SERIES UNITS (2 HEAT, 2 COOL)		
THERMOSTAT-SECTION C1		
Supersedes Form No.	New Form No. 528,394W	

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FOR UNITS WITHOUT A CONTROL BETWEEN P16 & J16

TBI

TERM. NO.		UNIT FUNCTION
1	Y1	COOL 1
2	W1	HEAT 1
3	G	BLOWER
4		
5		
6	R	24V POWER
7	C	24V COMMON
8		
9		
10	10	POWER TO S1
11	11	
12	Y2	COOL 2
13	W2	HEAT 2
14	14	
15	15	

3 REMOVE P3 WHEN ECONOMIZER IS USED

2 THERMOSTAT SUPPLIED BY USER

1 J3 MAXIMUM LOAD 20VA 24VAC CLASS II

1 OPTIONAL-SECOND A7 INSTALLED IN RETURN AIR PROVIDES DIFFERENTIAL ENTHALPY CONTROL

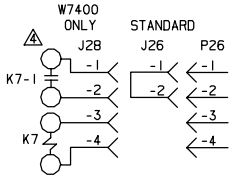
2 WHEN 1S RECEIVES POWER, 1S1 CLOSES.

3 FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR. REMOVE WHEN SECOND A7 SENSOR IS INSTALLED TO PROVIDE DIFFERENTIAL ENTHALPY CONTROL

4 WHEN W7400 CONTROL IS USED, REMOVE J26 JUMPER AND INSTALL J28. J28 AND K7 RELAY ARE PART OF W7400 KIT (74G11)

5 K11 NITE RELAY MAY NOT BE PART OF ECONOMIZERS ON UNITS BELOW 7.5T CAPACITY

6 JP9 USED ON 16 & 24 SERIES 1853,2753,3003 ONLY



LENNOX® Industries Inc.	WIRING DIAGRAM	3/93
ACCESSORIES		
EMD-14,17-M EMDH-16,24-M REMD-11,16,24-M (MODULATING ECONOMIZER)		
ECONOMIZER-SECTION D5		
Supersedes Form No. 529,063W	New Form No. 529,485W	

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DESCRIPTION	
KEY	COMPONENT
A6	CONTROL-ENTHALPY W7459A
A7	SENSOR-ENTHALPY
B7	MOTOR-DAMPER
J9	JACK-ECONOMIZER
J26	JACK-ENTHALPY
J28	JACK-W7400
J76	JACK-SENSOR ECONOMIZER
K7,-1	RELAY-W7400
K11,-1,2	RELAY-NITE SETBACK
P4	PLUG-ECONOMIZER
P9	PLUG-ECONOMIZER
P26	PLUG-ENTHALPY
P76	PLUG-SENSOR ECONOMIZER
R1	SENSOR-SUPPLY AIR
TBII	TERMINAL STRIP

DESCRIPTION	
KEY	COMPONENT
J3	JACK-UNIT,ECONOMIZER
J16	JACK-UNIT
P3	PLUG-LESS ECONOMIZER
P16	PLUG-UNIT
S1	THERMOSTAT-ROOM
TBI	TERMINAL STRIP-LOW VOLTAGE

C1 DIAGRAM WITH D5 DIAGRAM

Electromechanical Thermostat with Modulating Economizer

REMD24M

When a REMD24M economizer section is applied to the unit with electromechanical thermostat, three stages of cooling are available dependent on the actions of the economizer enthalpy control. By sensing outdoor temperature and relative humidity, the enthalpy control determines if outside air can be used as a first stage of cooling. If so, 1st stage cooling is handled by outdoor air dampers and 2nd stage cooling is handled by the compressor. The enthalpy control continuously adjusts the outdoor air dampers to maintain a balanced mixed air temperature. When outdoor air conditions become unsatisfactory for cooling, the outdoor air dampers and the compressors handle all cooling demand.

NOTE-In order to understand how optional controls affect the operation of the GCS24, you must first read and understand how all the GCS24 components work.

Factory jumper-plug P3 is removed from harness jack J3 and discarded. Economizer plug P4 replaces plug P3. These connections are made in the unit blower compartment.

Operation Sequence: C1 Diagram with D5 Diagram (economizer connected to the unit with electromechanical thermostat)

NOTE-In this operation sequence the unit diagram has been omitted in order to concentrate on the interaction between thermostat and economizer.

1- Economizer outdoor air dampers drive full closed anytime blower B3 is not operating (switched by K3-2 in the unit).

2- Damper motor terminal TR is powered by unit contactor K3 when there is a blower demand or by K25 when there is a heating demand. When 24VAC is applied to between terminals TR and TR1, the damper motor is energized and the outdoor air dampers open to minimum position.

3- Blower B3 is energized (indirectly) by thermostat terminal G. On a cooling demand, thermostat terminal G energizes contactor K3 which in turn energizes the blower (refer to operation sequence on previous page for exact sequence). When K3 energizes, K3-1 closes to energize the blower and K3-2 closes to energize the economizer (see step 2) and open the outdoor air dampers to minimum position.

Enthalpy Low, 1st Stage Cool:

4- Initial cooling demand Y1 is sent to enthalpy control A6 and terminal 1.

5- Enthalpy control A6 has determined that outside air can be used for cooling and has switched internal relays 1K and 2K.

6- Cooling demand is routed through enthalpy control to energize internal relay 1S. Internal contacts 1S1 close to complete a circuit through damper motor terminals T and T1.

7- When a voltage is applied across terminals T and T1 of damper motor, the damper motor energizes and outdoor air dampers open. Supply air sensor R1 varies the voltage across T and T1 and the outdoor air dampers open. Supply air sensor R1 varies the voltage across T and T1 and the outdoor air dampers adjust accordingly. 1st stage cooling is provided by outdoor air.

Enthalpy Low, 2nd Stage Cool:

8- Economizer outdoor air dampers remain open.

9- Additional cooling demand is routed from thermostat Y2 through enthalpy control terminals 3 and 5 to energize the 1st stage compressors. The 1st stage compressors provide all additional cooling.

Enthalpy High, 1st Stage Cool:

10- Enthalpy control internal relays 1K and 2K switch. Internal relay 1S is de-energized and 1S1 opens. Outdoor air dampers close to minimum position.

11- Cooling demand is sent from thermostat terminal Y1 through enthalpy control terminals 1 and 2 and through enthalpy control terminal 5 to energize the 1st stage compressors.

Enthalpy High, 2nd Stage Cool:

12- Additional cooling demand is sent from thermostat terminal Y2 through enthalpy control terminals 3 and 4 to energize the 2nd stage compressor.

Night Setback (optional field installed)

13- Optional field installed time-clock and night thermostat S12 must be connected for night setback operation.

14- Blower B3 operates only during a heating demand when night thermostat is closed.

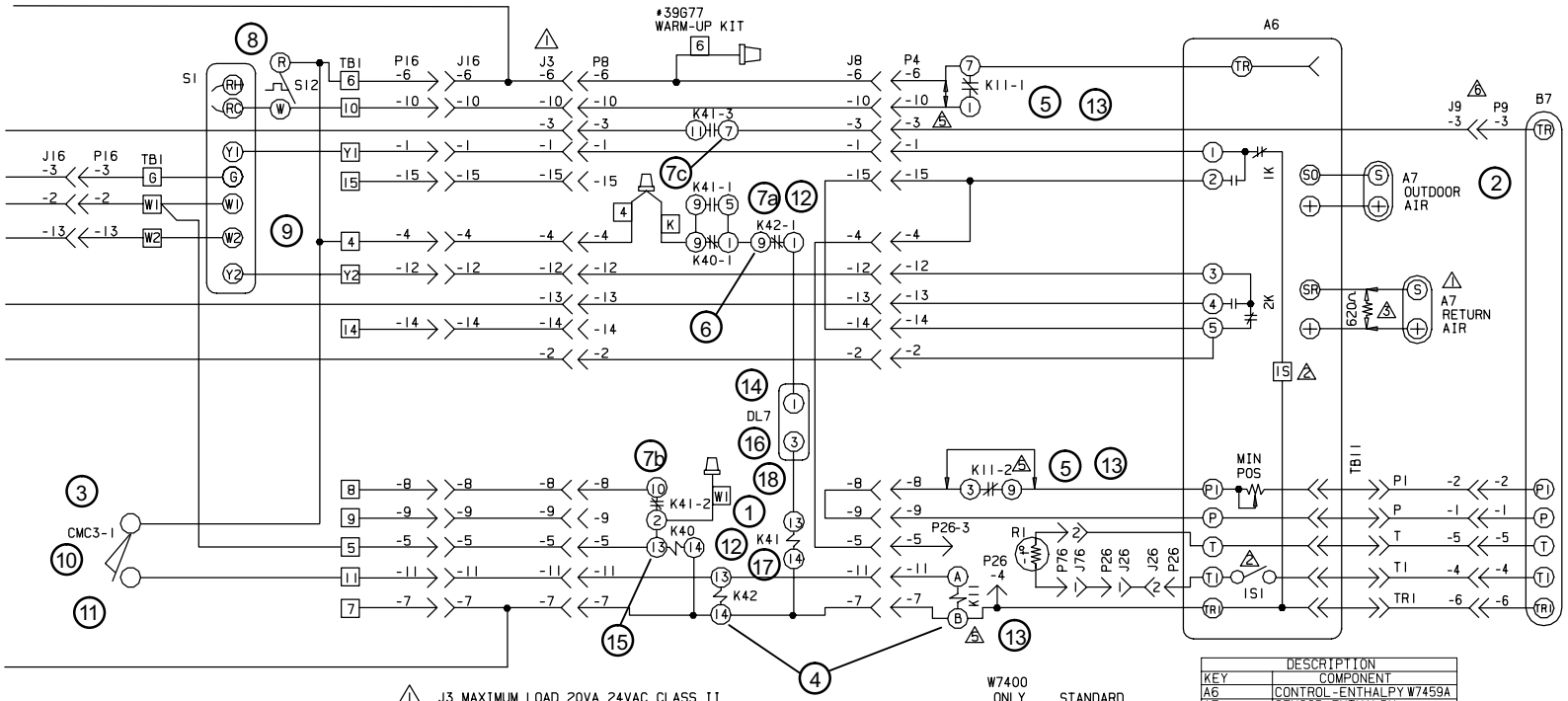
15- When clock contacts close, relay K11 energizes. Contacts K11-1 open to disable the day thermostat and contacts K11-2 open to drive the dampers full closed.

16- Night thermostat S12 is typically set with setpoints below thermostat S1. During unoccupied periods, K11-1 opens while S1 is disabled. When S12 closes, power is applied to S1 and the unit operates normally. When the setpoint is reached, S12 opens, S1 is disabled and unit operation stops.

17- Shortly before the building is to be occupied, clock contacts open to de-energize relay K11. Contacts K11-1 close to restore power to thermostat S1 and contacts K11-2 close to restore power to the minimum positioner. Outdoor air dampers open to minimum position during blower operation.

C2-1 diagram with D5 diagram

electromechanical thermostat with modulating economizer and warm-up



DESCRIPTION	
KEY	COMPONENT
CMC3-1	timer-clock
DL7	delay-readout
J3	jack-economizer
J8	jack-warm up kit
J16	jack-unit
K40,-1	relay-warm up kit-ht latch
K41,-1,2,3,4	relay-warm up kit-latch
K42,-1	relay-warm up kit-clock
P8	plug-warm up kit
P16	plug-unit
S1	thermostat-room
S12	thermostat-nite
TB1	block-terminal(low volt)

LENNOX Industries Inc.	WIRING DIAGRAM	8/87
ACCESS-COMBINATION UNITS-ROOFTOP		
THERMOSTAT SECTION FOR GCS,CHA,CHPII & I6 SERIES UNITS WITH WARM UP KIT		
THERMOSTAT SECTION-C2-1		
Supersedes Form No.	New Form No. 528,152W	

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DESCRIPTION	
KEY	COMPONENT
A6	CONTROL-ENTHALPY W7459A
A7	SENSOR-ENTHALPY
B7	MOTOR-DAMPER
J9	JACK-ECONOMIZER
J26	JACK-ENTHALPY
J28	JACK-W7400
J76	JACK-SENSOR ECONOMIZER
K7,-1	RELAY-W7400
K11,-1,2	RELAY-NITE SETBACK
P4	PLUG-ECONOMIZER
P9	PLUG-ECONOMIZER
P26	PLUG-ENTHALPY
P76	PLUG-SENSOR ECONOMIZER
RI	SENSOR-SUPPLY AIR
TBII	TERMINAL STRIP

1. OPTIONAL-SECOND A7 INSTALLED IN RETURN AIR PROVIDES DIFFERENTIAL ENTHALPY CONTROL
2. WHEN IS RECEIVES POWER, ISI CLOSES.
3. FACTORY INSTALLED 620 OHM, 1 WATT, 5% RESISTOR. REMOVE WHEN SECOND A7 SENSOR IS INSTALLED TO PROVIDE DIFFERENTIAL ENTHALPY CONTROL
4. WHEN W7400 CONTROL IS USED, REMOVE J26 JUMPER AND INSTALL J28. J28 AND K7 RELAY ARE PART OF W7400 KIT (74G11)
5. K11 NITE RELAY MAY NOT BE PART OF ECONOMIZERS ON UNITS BELOW 7.5T CAPACITY
6. JP9 USED ON I6 & 24 SERIES 1853,2753,3003 ONLY

LENNOX Industries Inc.	WIRING DIAGRAM	3/93
ACCESSORIES		
EMD-I4,I7-M EMDH-I6,24-M REMD-II,I6,24-M (MODULATING ECONOMIZER)		
ECONOMIZER-SECTION D5		
Supersedes Form No. 529,063W	New Form No. 529,485W	

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C2-1 DIAGRAM WITH D5 DIAGRAM

Electromechanical Thermostat with Modulating Economizer and Warm-Up

WARM-UP KIT

An optional feature of the REMD24M economizer is a warm-up kit which holds the economizer outdoor air dampers closed during night heat operation and while the GCS24 is warming the building the morning after. The warm-up kit temporarily disables the economizer (outdoor air dampers are held closed) during morning warm-up to keep cool outside air from being mixed with return air. Once the temperature setpoint is reached, the economizer is allowed to operate normally (outdoor air dampers open to minimum position to allow required minimum air exchange).

NOTE-In order to understand how optional controls affect the operation of the GCS24, you must first read and understand how all the GCS24 components work.

NOTE-
The warm-up kit requires the use of optional time clock CMC3-1.

Optional night thermostat S12 must be installed.

The warm-up kit can only be installed in GCS24 units with REMD16 economizer.

WARNING-CONNECT ONLY RELAY KITS DESIGNED FOR THIS CONTROL SYSTEM. RELAY KITS DESIGNED FOR OTHER CONTROL SYSTEMS ARE NOT COMPATIBLE AND CONTROL DAMAGE OR FAILURE WILL RESULT. FOR EXAMPLE, A W973 RELAY KIT MUST NOT BE CONNECTED TO A ELECTROMECHANICAL THERMOSTAT CONTROL SYSTEM.

WARNING-BE CAREFUL TO CONNECT RELAY KITS TO THE PROPER JACK AND PLUG IN THE GCS24 BLOWER COMPARTMENT. REFER TO WIRING DIAGRAM. IMPROPER CONNECTION WILL CAUSE CONTROL FAILURE.

The warm-up kit installs in the control mounting area of the GCS24 filter access compartment. No wiring is required. Jumper plug P3 is removed and discarded. Warm-up kit harness plug P8 connects directly into jack J3 in the blower compartment. Warm-up kit harness jack J8 connects to economizer harness plug P4.

Operation Sequence:

NOTE-This operation sequence emphasizes warm-up kit operation. Unit diagram has been omitted.

1- When relay K41 is energized during normal operation, the economizer functions normally and is locked-in until night setback. When relay K41 is de-energized, economizer is disabled.

2- Economizer outdoor air dampers drive full closed anytime blower B3 is not operating.

Night Setback:

3- Time clock CMC3-1 should be adjusted so that clock contacts remain closed during hours when the building is not occupied. The contacts are set to open shortly (usually 1 hour) before the building is to be occupied.

4- When clock contacts close, relay K11 in the economizer and K42 in the warm-up kit are energized.

5- Contacts K11-1 open to disconnect power to thermostat S1. K11-2 open to drive the dampers full closed.

6- Contacts K42-1 open to disengage relay K41.

7- When relay K41 disengages, power is disconnected to the economizer:
a-Contacts K41-1 open to lock-out economizer operation.
b-Contacts K41-2 close (not used).
c-Contacts K41-3 open to disconnect power to the economizer.
d-Contacts K41-4 open (not used).

8- During unoccupied periods, K11-1 opens and S1 is disabled. When S12 closes, power is returned to S1 and the unit operates (heating demand) normally. When S12s setpoint is reached, S12 opens, S1 is disabled and unit operation stops.

9- Blower operates only on demand energized by GCS24 heat relay K25 when S12 is closed.

10- Thermostat S1 and economizer remain inoperable until time clock CMC3-1 contacts open.

First Heat Demand After Night Setback (Begin Warm-Up)

11- Shortly before the building is to be occupied, time clock CMC3-1 contacts open.

12- Relay K42 disengages and contacts K42-1 close.

13- Relay K11 disengages. Contacts K11-1 close to allow power to thermostat S1. Contacts K11-2 close to allow outdoor air dampers to open. Note that dampers remain closed until relays K3 and K41 are energized.

14- Since contacts K40-1 are normally closed and contacts K42-1 have just switched closed, timer DL7 is energized. Timer DL7 is normally open and closes 30 sec. after being energized.

15- If heat demand W1 reaches relay K40 before delay DL7 closes, contacts K40-1 open, delay DL7 loses power and resets and the economizer is locked-out for the first heat demand by relay K41 (contacts K41-3 remain open). If heat demand W1 reaches relay K40 after delay DL7 closes, relay K41 energizes and the economizer locks-in for the day until night setback.

16- When first heat demand is satisfied, relay K40 disengages and relay K40 contacts K40-1 close. Relay contacts K42-1 are already closed (clock contacts open). Time delay DL7 begins 30 sec. count. If a second heat demand W1 does not reach relay K42 within 30 sec., time delay DL7 contacts close and relay K41 energizes.

17- When relay K41 energizes, the economizer is allowed to operate normally, controlled by relay K3:
a-Contacts K41-1 closes to lock-in economizer operation until night setback.
b-Contacts K41-2 open (not used).
c-Contacts K41-3 close to allow power to the economizer.
d-Contacts K41-4 close (not used).

18- Once energized, relay K41 locks-in and the economizer operates until relay K42 is energized by night setback (contacts K42-1 open to disengage relay K41).

NOTES